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Aircraft Access to SWIM

T02D01: AAtS Initial Concept of Use Document with Use Case Scenarios

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Aircraft Access to SWIM

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0.1	Initial Draft Document	30 November 2011
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EXECUTIVE SUMMARY

The goal of Aircraft Access to System Wide Information Management (AAtS), part of the Next Generation Air Transportation System (NextGen) initiative, is to provide access to National Airspace System (NAS) data currently not available to the flight crew. Providing this data to targeted users will increase situational awareness by providing constantly updated information on Air Traffic Management (ATM) activity, Traffic Management Initiatives (TMIs), traffic along a route of flight, departure and destination airport operations, weather, changes in relevant NAS infrastructure and other activity potentially affecting aircraft operations. Data available through AAtS will not be used to provide mission-critical data or command and control applications.

AAtS will be implemented in phases. In the initial phase, the primary focus of this document, the Federal Aviation Administration (FAA) will provide System Wide Information Management (SWIM) data to the aircraft via an FAA gateway. Additional phases currently in planning will include bidirectional communication between the FAA and AAtS users.

The FAA is responsible for and is the prime provider of NAS data and the AAtS gateway. The FAA will specify the specific data made available on SWIM with input from the public sector. There likely will be two types of data “pushes” supported by AAtS. The first flow will include a stream of all the data specified by the FAA for AAtS. The second flow will be filtered based on the commercial vender requests or subscriptions. This flow will provide selected data elements for specific parts of the NAS such as an airport, region of the country, etc.

In steady state, private vendors will access NAS data from the FAA and use it to generate and provide useful information to aircraft as a purchased service or product.

The SWIM-supported services available through AAtS will increase as additional NAS systems and subscribers publish data to SWIM. Ultimately, AAtS will enable flight crews to take part in collaborative decision making to support strategic management of operations of there flight.

1 INTRODUCTION

The Next Generation Air Transportation System (NextGen) is designed to increase efficiency and capacity, improve safety, and to provide more choices to aircraft operators as they move people and goods through the NAS. The transformation to NextGen operations requires programs and technologies enabling more efficient operations, including streamlined data communications capabilities. SWIM is one of seven transformational programs within the NextGen portfolio of programs [1] driving this transformation of the NAS. Aircraft Access to SWIM (AAtS) is the flight deck extension of SWIM.

1 BACKGROUND

SWIM is an information platform that will facilitate simultaneous information sharing among pilots, air traffic controllers, airline dispatchers, the military, government agencies, and other users of the NAS to create an up-to-date, shared situational awareness of the ATM operational environment on the ground and in the air. SWIM will provide an open, flexible, and secure information management architecture for sharing NAS advisory data and enabling increased common situational awareness and improved NAS agility.

2 DOCUMENT SCOPE AND OVERVIEW

AAtS will provide the gateway to NAS services to a flight crew during all phases of flight. Only non-safety critical flight information will be available. When fully implemented AAtS will provide a dynamic bi-directional channel between pilots, controllers, Airline Operation Centers (AOC), Flight Operations Centers (FOC), and other users of the NAS enabling all members access to the same information. This document describes the general AAtS concepts that will support NextGen users through the

implementation of AAtS into the NAS, the current information services, current operational gaps in information distribution and the solution AAtS provides. The appendices provide supplemental information to the AAtS concept with use case scenarios giving an overview of how the AAtS provided information could be used in an operational setting.

This initial AAtS concept of use (CONUSE) is written from the user's operational perspective, serving as a baseline for more analyses and to inform the final CONUSE and final AAtS use case scenarios to be developed in Fiscal Year (FY) 2012.

2 Current Operational Environment

Currently the flight deck receives NAS data and information in a number of ways; the most common is through two-way communications with air traffic controllers, on-board weather radar, and flight deck data link, two-way company radios/communications with the AOC/FOC, and Aircraft Communications Addressing and Reporting Systems (ACARS). Some information can be delivered to the cockpit of commercial aircraft via data link (e.g., ACARS); however, this information is limited and the current NAS operation relies heavily on voice communications. Some of the information provided by air traffic controllers to pilots falls into the category of additional services, such as Airmen Meteorological Information (AIRMET) or Significant Meteorological Information (SIGMET). Today, flight crew situational awareness is generally derived from ATC communications, on-board weather radar (range 50 to 150 nautical miles [nm] with limited detail), feedback from listening to other pilot-controller communications and other on-board information systems.

The following sections describe the products and services (weather, aeronautical and both flight and flow management) and their functions, how the information from these services is disseminated, and to whom (air traffic controllers/traffic flow managers, AOC/FOC, and the flight deck). The information gaps found in the current system and how these gaps impact efficiency of operations are also identified and discussed.

3 Current Services

3.1 Weather

The consistent provision of timely, high-quality weather information is essential to support operational decisions made by pilots, controllers, and dispatchers. Aviation weather data is collected from sources both internal

and external to the FAA including commercial sources. Table 2 in Appendix A presents the current weather sensor and distribution services/products, their functional description and the AAtS stakeholders' access to them.

3.2 Aeronautical Information Management (AIM)

AIM information is directed to three sets of users from three primary sources. The sources are NOTAM Distribution Program (NDP), NAS Aeronautical Information Management Enterprise System (NAIMES) and Military Operations (MILOPS). The three sets of users are air traffic control, aviation and flight operations centers and aircraft flight crews. Table 3 in Appendix B describes AIM services and functions.

3.3 Flight and Flow Management

Today, Traffic Flow Management controls volume or system impacts through a number of Traffic Management Initiatives (TMIs) and programs. Table 4 in Appendix C lists the available tools used by air traffic controllers and traffic flow managers to make adjustments to route impacts, capacity/volume issues, and NAS system issues.

4 Operational Need

4.1 Information Access and Distribution Constraints

Current constraints to accessing aviation-related information include:

- No consolidated data source for all available aviation-related information
- No air-to-ground channel for pilots to obtain shared NAS services and information
- Reliance on voice communications for in-flight aviation
- Limited access to NAS information and services.

These constraints reduce the scope of planning and narrow the ability of all users to make dynamic, strategic decisions, thus reducing agility of NAS operations.

Timely distribution of NAS information is important for the flight crew to make informed decisions to the safest and most efficient extent possible. Often the currency of information among cockpit crews, traffic management, controllers, and AOC/FOC is uneven resulting in inefficient planning, excessive time lapsed, and a need for additional communication to compensate for the quality and timeliness of information. Flight crews do not have access to the same information available to air traffic controllers,

traffic managers, or AOC/FOC. As a result of this information mismatch the flight crew does not have a complete picture of the NAS environment.

3 PROPOSED AATS OPERATIONAL CONCEPT

5 DESCRIPTION OF DESIRED CHANGE

The major NAS operational change from existing operations is the provision of non-safety critical operational information to the flight deck provided via AAtS services to aid in creating common situational awareness shared with the Air Navigation Service Provider (ANSP) and operation centers throughout the entire flight. The flight crew moves from being a sole operator to an engaged, collaborative decision maker. AAtS is the first step in providing NAS information directly to the flight crew, on demand.

6 AATS CONCEPT DESCRIPTION

Initially, AAtS will use existing NAS and aircraft infrastructure (e.g., SWIM, FAA Telecommunications Infrastructure [FTI], and Electronic Display Devise[1]) to promote the AAtS goal of facilitating a more cohesive and efficient planning and decision-making environment for all NAS users; one which promotes collaborative decision making and a common situational awareness during all phases of flight [9]. AAtS makes the right information available at a time when it can be used by the flight crew and extends flight planning well beyond when the aircraft doors close to virtually every phase of flight, improving NAS performance, efficiency, and safety.

6.1 **AATS SCOPE**

The AAtS data set is intended to provide supplementary/advisory data regarding the NAS not presently available to the flight deck. It is not intended for command and control applications.

1 Electronic Display Device (EDD) is a general term used in this document to represent EDD that have been modified to display AAtS information by a third party vendor or a display developed by a third party vendor to display AAtS information. Commercial vendors will create applications for the display of AAtS data

7 AATS FUNCTIONAL ARCHITECTURE

A phased approach will be executed to develop the AAtS functional architecture [9]. There are three elements in the initial phase of AAtS:

- FAA-supplied NAS data.
- FAA-supplied gateway to access NAS data.
- Commercial vendors creating applications to use available NAS data.

7.1 NOTIONAL AATS ARCHITECTURE

Multiple key components comprise AAtS, which are captured in Figure 1 below.

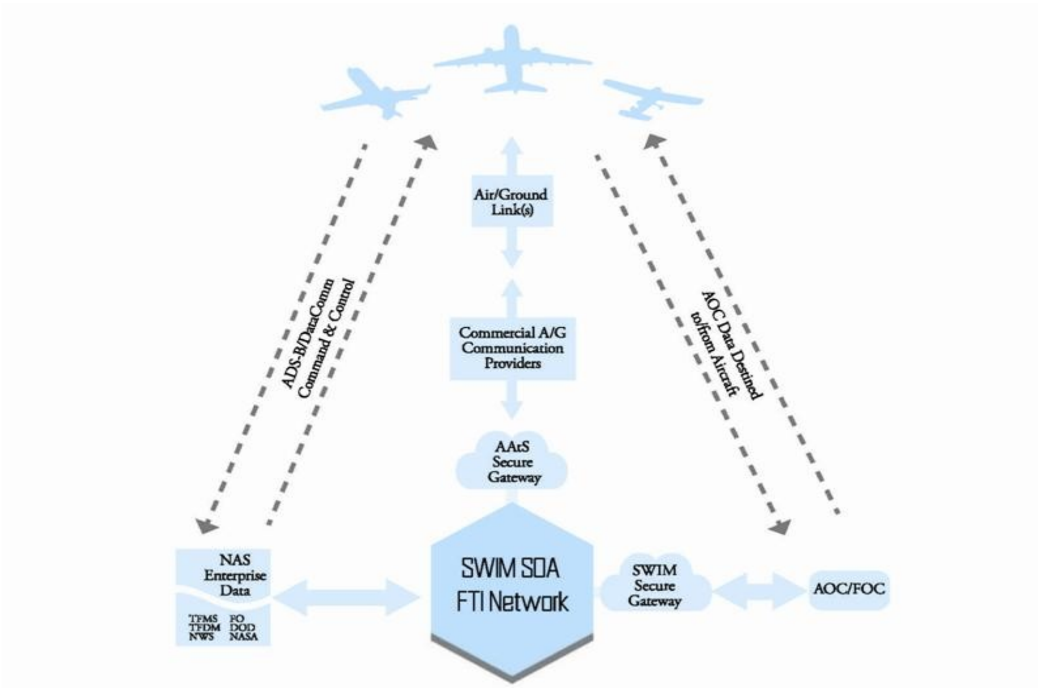

FIGURE 1 NOTIONAL AATS ARCHITECTURE

Commercial air/ground (A/G) communication providers will provide the flight deck with a secure connection to the AAtS Secure Gateway necessary for accessing the SWIM SOA FTI Network. The AAtS Secure Gateway will control and enable access to data. This network will enable availability of information from FAA data providers, which can be from the following three data categories [9], [3]:

1. Flight and Flow Data consists of near real-time information regarding aircraft flight plans, schedules, user preferred routes, TMIs, traffic demands and forecasts, and airport capacities and delays
2. Weather Information includes forecast and measured meteorological conditions, plus weather advisories. Future access may include the complete NNEW, 4-D WX Data Cube. In Segment 1, this data will

come from Integrated Terminal Weather System (ITWS), Corridor Integrated Weather System (CIWS) and Pilot Report of actual weather conditions, (PIREPs)

3. Aeronautical Information Management includes information about the operation of the NAS infrastructure, Navigational Aid (NAVAID) equipment status, Notices to Airmen (NOTAMs), Special Activity Airspace (SAA), and Temporary Flight Restriction (TFR) areas.

The FAA will define the requirements to connect to the AAtS Secure Gateway, which is included in the System Architecture. The interface between the commercial A/G communication providers and the aircraft will be specified by industry and approved by the FAA.

7.2 FUNCTIONAL MODE OF OPERATION

While the FAA is providing the gateway to the SWIM network, the functional modes of operation and display of the information is dependent on third party developers and NAS end users. These modes of operations and program benefits will be identified as the AAtS concept is developed and through human-in-the-loop (HITL) testing.

8 OBJECTIVES AND IMPLEMENTATION TIMELINE

Initial AAtS concepts envision information sharing by FAA and NAS users that enables the flight crew to participate in the conduct of NAS operations. Increased participation will result in both improved NAS performance and NAS user satisfaction, supporting the NextGen initiative to make NAS information available to assist NAS user decision-making.

Planned expansion of AAtS includes a bidirectional communication channel that allows NAS users to exchange data, expanding the capacity for collaborative decision-making.

4 OPERATIONAL AATS JUSTIFICATION

9 IMPACTS ON CURRENT OPERATIONS

AAtS will enable the flight crew to shift from today’s tactical flight operations to an increasingly strategic management of flight from gate-to-gate. This document anticipates new services to be available to AAtS users as SWIM expands its services. These services may include weather, AIM, and TFM information, and other flight and flow products. These new services would allow flight crews to monitor changes in weather along routes of flight, receive alerts of potential TFM programs so routes to

reduce delays could be planned. AAtS provides an alternate means to receive this information without relying entirely on air traffic control service providers. The expected impacts on FAA systems include [5]:

- Provision of a secure gateway enabling commercial providers to transmit available NAS information to/from subscribing aircraft
- Extension of SWIM capabilities through AAtS to enable data sharing through a single gateway.
- SWIM processes and policies may need to be reviewed as the AAtS project testing and development reveals new uses for SWIM processes.
- Data Acquisition Services could be used to support the movement of aircraft data delivered via AAtS as business and use case analysis determines a need for additional operational data.

10 Potential Benefit of AAtS

AAtS will provide on-demand access to non-safety critical information that the flight deck does not currently have. The AAtS gateway will provide all NAS users with the means to access the data and information provided by SWIM enabled services to have common situational awareness of the information being used in the decision making process. It will meet the NextGen goal of providing common situational awareness on the flight deck culminating in increased capacity, increased efficiency, and improved safety.

AAtS enables a number of NextGen goals as defined in FAA NextGen Implementation Plan, March 2011.

- Directly supports SWIM: AAtS directly supports SWIM by providing the flight crew access to the SWIM enabled services from the aircraft flight deck while both airborne or on the airport surface. AAtS also supports the goal of CATMT providing the flight crew with the information needed to make informed decisions.
- Support growing traffic demands: current forecast has aviation traffic growing two to four times the current levels in the next 25 years. At current levels, select areas in the NAS are at capacity with current technology. Any impacts to the system, such as thunderstorms and runway (RWY) closure for example, can have a major impact on NAS operations. AAtS can provide ways to keep the flight crew informed of impacts and provide the crew with the means to make informed decisions.

- Reduce system delays: AAtS will keep the pilots informed of real time NAS operations, providing them a look at the bigger picture of how the NAS is functioning and how they can work around bottle necks, weather systems, volume demands, and operate on time.
- Increase informational exchange: the primary goal of the initial phase of AAtS is to provide the flight deck near real-time information. The second phase will make the aircraft a weather-reporting platform in the system, while also allowing the flight crew the ability to file PIREPs from the aircraft, ensuring that reports are filed in real-time. The two-way communications between air traffic controllers and the flight deck can be reduced by the flight deck having access to PIREPs or the flight deck being able to upload PIREPs will reduce frequency congestion.

11 Organizational Changes Required

No FAA organizational changes are envisioned from the use of AAtS on the flight deck.

5 AAtS Initial Operational Use Case Scenarios

Operational use case scenarios demonstrate how a system operates under specific conditions. Scenarios will test the utility of AAtS services under expected operational conditions with intended users of these services. It is expected that multiple use case scenarios will be developed as the AAtS concept matures. The scenarios described in this document provide initial, high-level operational views of AAtS in the far-term; they describe how the types of AAtS information (Flight and Flow Management, Weather, Aeronautical Information, and NAS Status Information) will be used.

AAtS users will work with third party vendors to develop specific application requirements based on their operational needs for accessing SWIM services. These will include user-defined data access requirements and the method for accessing and displaying the data/information. This proposed application supports collaborative decision-making and situational awareness.

Each scenario will progress through each phase of flight; flight planning, pushback / taxi (ground movement), takeoff / climb, domestic en route cruise, descent / arrival, and final approach / landing. The goal is to identify what non-safety critical information AAtS can provide to improve the situational awareness of the flight crew to aid their decision making. Each scenario is designed to show the operational benefits of AAtS to

stakeholders and the NAS. These scenarios include comparative descriptions of the current delivery and use of NAS information versus what this will entail once AAtS is implemented to highlight operational benefits.

Four detailed initial use case scenarios have been developed to define the operational use of AAtS (see Appendix E). Each use case scenario has been created with a specific purpose and goal to highlight and each will cover a different NAS event to demonstrate how AAtS is envisioned to be used in the NextGen environment. Table 1 below includes an overview of the main themes of the operational use case scenarios.

TABLE 1 USE CASE SCENARIO OVERVIEW

Scenario	Purpose	Route	Conditions	Actors
Transcontinental Airline operating under normal conditions (LAX to JFK under Visual Meteorological Conditions [VMC])	Fully exercise AAtS capabilities and identify benefits under normal operating conditions with on-demand NAS	Transcontinental LAX-JFK (Depart LAX at 1645Z) SAC J32 FMG J94 OBK J94 PMM J70 LVZ LENDY5	VMC, RWY construction at JFK, conform to route MIT into ZNY during the afternoon peak demand period, NOTAM for taxiway closure	Flight Crew, AOC/FOC, CPCs, Traffic Flow Managers, ANSP
Domestic Airline Flight (Severe Weather Event) unpredictable adverse	Demonstrate use of AAtS during convective WX, unpredictable adverse weather conditions that impact route	Domestic flight; SFO/ORD (Depart SFO at 1230Z) BCE J100 EKR BFF J94	Convective weather conditions En route not impacting arrival airport, NAS	Flight Crew, AOC/FOC, CPCs, Traffic Flow

convective weather event with potential for reroutes.	during flight	DBQ JVL BULLZ1	re-route	Managers, ANSP
Domestic Private Jet (GA) On-demand (unscheduled) Flight operating under predictable weather conditions	Demonstrate use of AAtS by flight crew without AOC/FOC support, demonstrate GA benefits from AAtS information	Domestic GA flight: ORD EON V399 KENLA V128 JELLS IND	VMC weather conditions, multiple flights from the Chicago area to IND	Flight Crew, CPCs, Traffic Flow Managers, ANSP
Airline operating under normal conditions (ORD to IAD Commercial Flight IFR Flight, Snow at both Airports)	Demonstrate use of AAtS during non-convective, but predictable adverse weather conditions that impact flight planning to support reduced unnecessary flight and taxi movements	Domestic flight: ORD/IAD (Depart ORD at 1655Z) ORD EARND ELANR EMMLY ERECO IIU J8 HVQ SHNON2 IAD	Snow at ORD and IAD, snow removal may be a factor at both airports with RWY closures, GDP/GS possible, deicing at ORD causing reduced Arrival/ Departure Rate	Flight Crew, AOC/FOC, CPCs, Traffic Flow Managers, ANSP

ACRONYMS

AAtS	Aircraft Access to SWIM
4-D WX Data Cube	4-Dimensional Weather Data Cube
ACARS	Aircraft Communications Addressing and Reporting Systems
ADDS	Aviation Digital Data Service
ADS-B	Automatic Dependent Surveillance – Broadcast
AFP	Airspace Flow Program
AIM	Aeronautical Information Management
AIRMET	Airmen's Meteorological Information
AISR	Aeronautical Information Services Replacement
ANSP	Air Navigation Service Provider
AOC	Airline Operating Center
ASOS	Automated Surface Observing Systems
ARTCC	Air Route Traffic Control Center
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
ATM	Air Traffic Management
ATCSCC	Air Traffic Control System Command Center
AWOS	Automated Weather Observing System
A/G	Air/Ground
BCE	Bryce Canyon VOR
BFF	Scottsbluff VOR
CATMT	Collaborative Air Traffic Management Technologies
CCFP	Collaborative Convective Forecast Product
CIWS	Corridor Integrated Weather System
CIX	Collaborative Information Exchange
CONUS	Contiguous United States (the 48 contiguous states)
CONUSE	Concept of Use
CoSPA	Consolidated Storm Prediction for Aviation
CPC	Certified Professional Controller
Data Comm	Data Communications
D-ATIS	Digital-Automatic Terminal Information Service
DBQ	Dubuque VOR
EDCT	Expect Departure Clearance Time
EDD	Electronic Display Device
EDD	Electronic Flight Bag
EKR	Meeker VOR

EON	Peotone VOR
ERAM	En Route Automation Modernization
FAA	Federal Aviation Administration
FCA	Flow Constrained Area
FEA	Flow Evaluation Area
FMG	Mustang VOR
FMS	Flight Management System
FOC	Flight Operation Centers
FSS	Flight Service Station
FTI	FAA Telecommunications Infrastructure
FY	Fiscal Year
GA	General Aviation
GDP	Ground Delay Program
GS	Ground Stops
GTG	Graphical Terminal Guidance
HVQ	Charleston VOR
HITL	Human-in-the-Loop
IAD	Washington Dulles International Airport
IFR	Instrument Flight Rules
IIU	Louisville VOR
IND	Indianapolis International Airport
ITWS	Integrated Terminal Weather System
JFK	John F. Kennedy International Airport
JVL	Janesville VOR
LAADR	Low Altitude Arrival/Departure Routing
LAX	Los Angeles International Airport
LLWSAS	Low Level Wind Shear Advisory System
LVZ	Wilkes-Barre VOR
MDCAR	Meteorological Data Collection and Reporting System
METAR	Meteorological observation message for routine aviation
MILOPS	Military Operations
MIT	Miles-in-trail
MNIT	Minutes-in-trail
NAIMES	NAS Aeronautical Information Management Enterprise System
NAS	National Airspace System
NAVAID	Navigational Aid

NES	NOTAM Entry Systems
NextGen	Next Generation Air Transportation System
NEXRAD	Next-Generation Radar
NGIP	NextGen Implementation Plan
NNEW	NextGen Network Enabled Weather
NM	Nautical Miles
NOTAMs	Notices to Airmen
NSRR	NAS Service Registry Repository
NDP	NOTAM Distribution Program
NTML	National Traffic Management Log
NWS	National Weather Service
OBK	Northbrook VOR
OI	Operational Improvement
OIS	Operational Information System
OPS	Operations
ORD	Chicago O'Hare International Airport
PIREPs	Pilot Reports
PMM	Pullman VOR
Prog	Progress
RAPT	Route Availability Planning Tool
RVR	Runway Visual Range
RWY	Runway
SAMS	Special use Airspace management System
SIGMET	Significant Meteorological Information
SAA	Special Activity Airspace
SAC	Sacramento VOR
SFO	San Francisco International Airport
SOA	Service Oriented Architecture
SUA	Special Use Airspace
SWAP	Severe Weather Avoidance Plan
SWIM	System Wide Information Management
TAF	Terminal Aerodrome Forecast
TAMDAR	Tropospheric Airborne Meteorological Data Reporting
TCA	Tactical Customer Advocate
TELCON	Telephone conferences
TBFM	Trajectory-Based Flow Management (TBFM)
TDWR	Terminal Doppler Weather Radar

TFDM	Tower Flight Data Management
TFMS	Traffic Flow Management System
TFR	Temporary Flight Restriction
TMIs	Traffic Management Initiatives
TMU	Traffic Management Unit
TRACON	Terminal Radar Approach Control
USNS	United States NOTAM System
VIL	Vertically Integrated Liquid Water
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omni-directional Range
Wx	Weather
ZAU	Chicago ARTCC
ZDV	Denver ARTCC
ZOB	Cleveland ARTCC
ZMP	Minneapolis ARTCC
ZNY	New York ARTCC

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[1]From System Wide Information Management, Program Overview, System Description

[2] FAA Order JO 7110.65T Air Traffic Control, Chapter 2. General Control, Section 1. General, 2-1-1. ATC SERVICE

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[6] http://www.ll.mit.edu/mission/aviation/faawxsystems/ciws.html

[7] http://www.ll.mit.edu/mission/aviation/faawxsystems/itws.html

[8] Aircraft Access to SWIM (AAtS) Candidate Data Elements, Volpe Center, December 3, 2010

[9] SWIM posium briefing 2011. Author: Washington, DC.

Appendix A. Current Weather Services/Products and Functions

TABLE 2 CURRENT WEATHER SERVICES/PRODUCTS AND FUNCTIONS

Service/ Product	Function	Near Real-Time Access		
		Flight Crew	ATM	AOC/ FOC
Controller Radar Display	This basic display is based on Vertically Integrated Liquid Water (VIL) levels. Areas with heavier rain display higher VIL levels which convey a higher possibility of convection		✓	
Next-Generation Radar (NEXRAD)	A network of high resolution Doppler weather radar that provides mosaic display that shows patterns of precipitation and its movement		✓	✓
Terminal Doppler Weather Radar (TDWR)	Doppler weather radar system used primarily for the detection of hazardous wind shear conditions and high-resolution precipitation data on and near major airports		✓	✓
ITWS	This system collects data from the FAA and National Weather Service (NWS) sensors as well as from airborne aircraft. The ITWS uses data from a number of systems including weather radar systems, lightning data, Low Level Wind Shear Alerting System (LLWSAS), Automated Weather Observing System (AWOS) and Automated Surface Observing Systems (ASOS). Automated weather products produced by the ITWS include wind shear and microburst detection and predictions, storm cell intensity and direction of motion, lightning information, detailed winds in the terminal area, and a 1-hour storm forecast. For selected terminals		✓	✓
CIWS	CIWS uses the same sources of data collect as ITWS providing a 2-hour forecast for the Continental United States (CONUS). CIWS provides the following data: • CIWS Precipitation Mosaic - Displays the current precipitation (VIL) mosaic product with storm		✓	✓

	motion vectors and storm top height tags, all overlaid on the visible satellite image. • CIWS 0-2 hour Precipitation Forecast - An animated loop shows 120 minutes of past weather, and then advances the forecast in 5 minute increments to the maximum forecast time of 120 minutes. • CIWS Growth and Decay Trends - Displays current regions of storm growth and storm decay trends. • CIWS Echo Tops Mosaic - Displays the current storm echo tops • CIWS Echo Tops forecast. • CIWS Winter weather forecast - conveys more information about cold-season aviation impacts by depicting snow, frozen precipitation, and rain			
FAA Weather Units	An area located in all FAA ARTCC and the ATCSCC that is staffed during most hours of operations. The weather unit provides real time weather briefings on current and forecast weather to air traffic control personnel and traffic management. The weather unit also participates in the development of the Collaborative Convective Forecast Product (CCFP). Weather forecast is used in traffic flow management planning		✓	✓
ASOS/AWOS	Automated surface units that measure and report the following basic weather elements at the airport: • Sky condition: cloud height and amount (clear, scattered, broken, overcast) up to 12,000 feet • Visibility (to at least 10 statute miles) • Precipitation: type and intensity of rain/freezing rain and snow • Obstructions to vision: fog, haze • Pressure: sea-level pressure, altimeter setting • Temperature: Ambient and dew point • Wind: direction, speed, and character (i.e., gusts, squalls) • Precipitation accumulation • Selected significant remarks: variable cloud height, variable	✓	✓	✓

	visibility, precipitation beginning/ending times, rapid pressure changes, pressure change tendency, wind shift, peak wind			
NWS Forecast	One example of a NWS forecast source is the internet accessible Aviation Digital Data Service (ADDS); examples of available data are the following: 1 Turbulence • Icing • Convection • Wind/Temp • Prognosis (Prog) Charts • Meteorological observation message for routine aviation (METAR) • Terminal Aerodrome Forecast (TAF) • Pilot Reports (PIREPs) • AIRMET/SIGMETs • Satellite • Radar Under each of the categories listed above are more detailed sources of information		✓	✓
Airborne Weather Radar	Provides a real-time view of the weather in front of the aircraft to the flight crew. The storm scope range varies from 50 to 150 nm but at the longer ranges, quality of the presentation may be degraded providing less detail to the scale of convection	✓		
World Wide Web weather sources	Any number of online resources which provide weather information		✓	✓

APPENDIX B. CURRENT AIM SERVICES AND FUNCTIONS

TABLE 3 CURRENT AIM SERVICES AND FUNCTIONS

Service/ Product	Function	Near Real-Time Access		
		Flight Crew[3]	ATM[1]	AOC/ FOC[2]
NOTAM Distribution Program (NDP)	Notices to Airmen (NOTAM) provide information about the status of airport systems, runways, Navigational Aids (NAVAIDs), etc. NOTAMs also provide outage information for systems not located at the airport but which are still pertinent to operations, such as a departure fix Very High Frequency Omni-directional Range (VOR). Updates on a NAS resource status that has changed or was not readily available during pre-flight planning are either broadcast via VOR or voice transmitted directly to airborne aircraft by controllers at ATC facilities, specialists at flight service stations/automated flight service stations, and personnel at AOCs and other facilities. The NAS status information includes changes to the operational status of airspace, airports, navigation aids, in-flight or ground hazards, traffic management directives, and other data. The advisory includes digital broadcasting of automatic terminal information service (D-ATIS) data, including runway status and weather information to pilots The NOTAM provides outage information for systems not located at the airport but which are still pertinent to operations, such as a departure fix VOR. Outage information may be placed on the D-ATIS or may be transmitted to affected flights via radio. As the status of critical equipment changes, this information may be broadcast from all positions simultaneously NOTAM Distribution Program (NDP) facilitates the automation, dissemination, and receipt acknowledgement of NOTAM messages in the Terminal and En Route domains		✓	✓

NAS Aeronautical Information Management Enterprise System (NAIMES)	NAIMES is responsible for managing real-time operational aeronautical information. Key capabilities of NAIMES include: • Creating, validating, and publishing NOTAMs. • Supporting flight planning activities • Supporting military airspace scheduling • Providing aeronautical information portals to enable operators' access to real-time aeronautical information Systems that are operated by NAIMES include: • United States NOTAM System (USNS) for managing and disseminating US NOTAMs. The USNS includes NOTAM Entry Systems (NES) as well as system-to-system interfaces • Aeronautical Information Services Replacement (AISR) for weather, NOTAM and flight planning functions supporting Air Traffic Controllers and Flight Service Stations • Pilot web, TFR web site, and other web sites that allow end users to get real time aeronautical information updates • Special Use Airspace Management System (SAMS) for managing military airspace schedules NAIMES provides highly reliable, scalable, and secure aeronautical information data services to users and access to critical data products and services to customers and stakeholders		✓	✓
Military Operations (MILOPS)	MILOPS utilizes advanced web-based technology to provide NAS users and planners with near real-time information, such as the status of Special Use Airspace (SUA)		✓	✓

[1] These personnel have real time access to AIM information, and for internal facility resources, they may be the controlling facility. For planned/scheduled events in a major component of the NAS, a detailed impact statement and plans for the impact are developed. Planned system impacts are carried out on the command center OIS page and as part of the command center Operational Plan developed during the Planning Telephone Conferences (TELCONS).

For unplanned events or failures, there is real time information sharing within the air traffic/traffic management committee through two-way commutations phone or interphone, status boards, or command center/facility advisories.

[2] These personnel have real-time access to AIM information from the NAS Aeronautical Information Management Enterprise System (NAIMES). For planned/scheduled events of a major component of the NAS a detailed impact statement and plans for the impact are available. Planned system impacts are

carried out on the command center OIS page and as part of the command center Operational Plan developed during the Planning TELCONS.

During periods of unplanned events, the command center provides information as it becomes available through advisories, direct phone calls, or during TELCONs. The command center also conducts TELCONs or sends advisories to update information during the event.

[3] Aircrews are provided with static information on known/planned events and their subsequent impact on the NAS prior to takeoff. As events change and the flight progresses, the flight crew only becomes aware of these events and their impacts on the NAS though airborne holding, reroutes, or other programs/initiatives that may impact the flight trajectory. Relaying real-time NAS status information to the flight crew is currently not in existence.

APPENDIX C. CURRENT TRAFFIC FLOW MANAGEMENT INITIATIVES AND PROGRAMS

TABLE 4 CURRENT TRAFFIC FLOW MANAGEMENT INITIATIVES AND PROGRAMS

Service/ Product	Function	Near Real-Time Access		
		Flight Crew	ATM	AOC/ FOC
Miles-in-trail/ minutes-in-trail (MIT/MNIT)	Assigned by traffic flow managers, assigned by controller. MIT used to apportion traffic into manageable flows, as well as, provide space for additional traffic (merging or departing) to enter the flow of traffic. MNIT number of minutes required between successive aircraft, normally used in a non-radar environment, or when transitioning to a non-radar environment, or additional spacing is required due.		✓	✓
Airborne - planned holding	Normally done when the operating environment supports holding and the condition is expected to improve shortly. This ensures aircraft are available to fill the capacity		✓	✓
Ground Stops (GS)	Override all other traffic management initiatives. Aircraft must not be released from a GS without the approval of the originator of the GS		✓	✓
Ground Delay Program (GDP)	Aircraft are held on the ground in order to manage capacity and demand at a specific location, by assigning arrival slots		✓	✓
Flow Constrained Area/Flow Evaluation Area (FCA/FEA)	FCA- A formalized FEA which requires positive traffic management initiatives to meter traffic through constrained area FEA- Geographic area identified as being impacted by weather or other constraint is shared with customers and FAA facilities to allow voluntary rerouting away from impacted area		✓	✓
Airspace Flow Program (AFP)	AFP allows traffic managers to control demand in the airspace in ways similar to how arrival demand at an airport can be managed through GDPs		✓	✓

Reroutes	Used by traffic flow managers to route large groups of aircraft clear of impacted airspace, normally used during severe weather events		✓	✓
Altitude restriction Capping/tunneling or Low Altitude Arrival/Departure Routing (LAADR)	All forms of altitude restricted flight used normally in the arrival or departure phase of flight		✓	✓
Advisories	Sent by ATCSCC to information FAA facilities and NAS users of NAS impacts, G/S, GDP, Re-Routes, etc. impacting NAS operations		✓	✓

APPENDIX D. ASSUMPTIONS AND CONSTRAINTS

TABLE 5 provides a list of the assumptions and constraints that will guide the design of the AAtS concept.

TABLE 5 AATS ASSUMPTIONS AND CONSTRAINTS

Assumption and Constraints
AAtS communications will be based on a publish/subscribe[2] message pattern. In addition, AAtS communication will use a request/response message exchange pattern where appropriate
AAtS connection will be provided through a private third party provider. The NAS customer will be required to develop their own interface for AAtS through a commercial A/G network services provider's infrastructure
AAtS will support all aviation subscribers, including large commercial airliners, business jets, helicopters, military, and general aviation (GA)
AAtS system would enable the flight crew ask for real time update for specific elements of the NAS, an airport ID "ORD" (Chicago O'Hare International Airport) a facility "ZAU"(Chicago Center) would return all input on Chicago Center. If a NOTAM for ORD was published the flight crew would receive notification of the change
AAtS supported services will provide non-safety critical information to flight crews
AAtS is largely "network agnostic." However, the selected network must have sufficient bandwidth to support the desired services. Bandwidth and support are depending on the NAS user and a third party vender to develop applications and commutations needs
AAtS services are envisioned for all phases of flight on the ground and in-flight. Use of an application will meet all required safety requirements for use in flight
AAtS will support all types of operations including Part 121 scheduled service, Part 135 air taxi, air charter and on-demand operators, and Part

Assumption and Constraints
91 general and business aviation
AAtS enabled services will be automatic and “bi-directional,” providing information to the flight deck and sending flight information to ground based services, example weather and flight condition data to weather (Wx) systems
The AAtS Gateway will include logic to automatically “route” messages to the correct ground user and aircraft based on embedded message information and business rules and provide security for proprietary data. The addressing and content-based routing requirements will be developed as the AAtS concept matures
The list of AAtS services and data defined in this document is not all inclusive, and as services are added to SWIM, they will be reviewed for AAtS utility
AAtS information will not interfere with avionics essential to the trajectory and safety of flight (e.g., Flight Management System [FMS])
In a joint effort, the FAA and aviation community will develop the AAtS interface and integration requirements
AAtS information provided to the aircraft shall not be used for command and control purposes and is intended serve as advisory information only

APPENDIX E. INITIAL USE CASE SCENARIO

Introduction

These initial use cases explore the impact AAtS may have on the NAS and were designed to illustrate potential uses for AAtS and to assess the impact on the NAS. The primary actor in each of the four scenarios is the pilot operating the aircraft. The aircraft, flight operation (commercial, private, GA) and events encountered during flight will alternate among the four scenarios to explore the AAtS concepts of use throughout all phases of flight. The scenarios for each use case are designed for the initial phase of AAtS where the data flow is unidirectional from the SWIM platform to the flight deck/flight crew.

Use Case Scenario Assumptions

General Assumptions

AAtS in the future is expected to provide the gateway for pilots to receive data provided by SWIM supported information services. It is proposed to use existing NAS infrastructure and avionics.

AAtS will provide advisory/supplemental information from data classifications:

- Aeronautical information
- Traffic flow management information
- Weather information.
- Each scenario will address a specific condition in the NAS and how AAtS will provide necessary information to the flight crew that will improve their situational awareness.
- All AAtS system architecture is fully developed and implemented.
- Aircraft are fully equipped to access SWIM services.
- Electronic Display Device (EDD) is a general term used in this document to represent EDD that have been modified to display AAtS information by a third party vendor or a display developed by a third party vendor to display AAtS information.
- Commercial vendors will create applications for the display of AAtS data
- Use case scenario covers the following phases of flight:
- Flight Planning/ Pre-flight
    - Pushback / Taxi
    - Takeoff / Climb

  - Domestic En Route Cruise
  - Descent / Final Approach
  - Landing / Taxi.
- Aircraft data is transmitted through ADS-B Out
- Aircraft are equipped with transponders and report their positions with ADS-B Out.
- Time of data transfer can be phase of flight based data transfer, predictable, periodic/preset data transfer, event based data transfer (sudden/unpredictable).
- FMS integration.

Roles and Responsibilities Assumptions

Managing the NAS, controlling air traffic and ensuring traffic moves safely and efficiently remain under the control of the decision makers, such as the AOC/FOC, ATCSCC, air traffic controllers and traffic flow managers. The flight crew will retain the ultimate responsibility to ensure separation from other aircraft and follow control instructions. Key considerations are:

- The flight crew will have the ability to choose alternate preferred routes given access to near-real time NAS data and information. The flight crew can set parameters for data sets to extract data and information pertinent to their flight path.
- Trajectory negotiations will not be made over AAtS; the pilot will still have to negotiate flight plan and route changes with the decision-making authority (AOC/FOC/Dispatch, if there is one available, and the appropriate ATC facility).
- Regulations in place to guide when and where Flight Crew can use AAtS.
- Available data has passed some security test, as have vendors and users.

Procedural Assumptions

- Information provided by AAtS will be advisory/supplemental. Information provided will not directly affect the trajectory of the aircraft or alter the route of flight. Data provided by AAtS will fall within three categories weather, traffic flow management, and aeronautical information.
- AAtS only provide non-safety critical information to the flight crew.
- AAtS will not provide control instructions.

- The flight crew will be able to subscribe to SWIM-provided services, as well as configure the receiving mechanism, the Electronic Display Device (EDD), to automatically retrieve information according to set parameters (e.g., airport information for the destination airport, weather information within a specified range of miles, etc.) during all phases of flight.

Scenario Constants

For the purposes of brevity and to maintain a consistent format for the presentation of the following scenarios, this section will define the constants that exist during flight operations and explain the different aspects as to the rules and regulations under which the Use Case Scenario flights are certificated and operating under.

Each scenario will transition through all phases of flight, flight planning, push back/taxi (Ground Movement), takeoff /climb out, Domestic En Route Cruise, Descent/Arrival and Final Approach and Landing. At the end of each scenario a benefits statement will be written and it will address the phase of flight and the expected benefits of AAtS.

There are several different FAA certifications that flights carrying passengers are flown under. The first three Use Case Scenarios in this document are flown under 14 CFR Part 121 Commercial Operations. The last one is a small corporate flight operation operating under 14 CFR Part 91, Under these different operating certifications, the rules governing the flight crew and the company's flight department differ, but all utilize the airspace the same way.

Flights conducted under 14 CFR Part 121 Commercial Operations, utilize an Airline Operation Center (AOC) or Flight Operation Center (FOC). Within this structure, flight dispatchers, which handle approximately 14 flights each, produce releases for every aircraft movement. It is the responsibility of the Pilot-in-Command (PIC) to ensure that each flight has the appropriate Dispatch Release and that the contents are accurate (121.687). The key items on the Dispatch Release are: 1) ID number (tail number of the aircraft to be flown); 2) flight number; 3) the departure airport, destination airport and alternate, if required; 4) Type operation, (IFR/VFR), route and altitude; 5) Minimum fuel to conduct the flight; 6) All Deferred Maintenance Items (DMI), and 7) Non Airworthiness Items (NAI). Other pertinent flight related

items such as current, forecast and depicted weather, Notices to Airman (NOTAMs) and fuel burn in relation to route fixes are incorporated within the release data. Load and balance data is usually forwarded to the flight crew via Aircraft Communications and Reporting System (ACARS), AIRINC or company VHF radio approximately 5-8 minutes after push back. The load and balance data, in addition to the Dispatch Release, is required for departure to assure the aircraft is loaded within operating limits and also provides the weights necessary to calculate the takeoff V speeds.

Each scenario presented that is operating under Part 121 will have a Dispatch Release and will be briefed by the flight crew, and discussed with the Dispatcher if necessary, after one of the crew has received the current Automatic Terminal Information Service (ATIS) and received their clearance and route from Clearance Delivery Controller. Once all necessary information has been collected, the flight crew performs the first phase of the flight, prior to pushback, known as the Clearance Brief.

In scenario four the flight is operating under Part 91, the aircraft operator contracts with a for fee flight planning service. This service provides flight planning function and weather briefing. For the scenarios the term Clearance Brief with cover all required pre-flight checks and briefings.

Traffic Flow Information Assumptions

- Types of TMIs: MIT, restrictions, speed and altitude restrictions, GDPs, GSs
- Applications available to AAtS include the following:
    - Turbulence reports
    - AIM data (i.e., NOTAM/D-ATIS).
- Aircraft can access TFM data through:
    - OIS page
    - Runway Visual Range (RVR)
    - Playbook
    - Operations Plan
- Airport status is conveyed through:
    - NOTAMS
    - D-ATIS
    - Closed
    - Active runway
    - GDP

    - GS.

Weather Information Assumptions

- Aircraft can access ITWS/CIWS
- Aircraft can access ADDS Weather
- Aircraft can access ASOS
    - Weather
        - CIWS/ITWS
        - ASOS
        - PIREPs

Aeronautical Information Assumptions

- AOC/FOC dispatch support throughout
    - AIM
        - NOTAMs
        - D-ATIS
- Airspace/aeronautical information conveyed through:
    - PIREP
    - TFRs
    - SUA
    - TMI
    - TFM
    - Routing
    - Severe Weather Avoidance Plan (SWAP).
- Flight information conveyed through:
    - Ride report
    - PIREP
    - Average out to off times for airport
    - ATCSCC status information
    - RVR
    - Playbook
    - Status Board
    - Operations (OPS) Plan.
- Available services and information:
    - TFM
        - ATCSCC system status page
        - RVR
        - Operational Plan
        - Operational information on JFK operation.

AAtS Initial Use Cases

This section provides scenarios to illustrate potential uses of AAtS from the pilot perspective, the impact of providing greater access to information not currently available. The proposed concepts of use are illustrated in four scenarios:

1. A transcontinental flight under VMC conditions;
2. A domestic airline flight under non-convective, predictable adverse weather conditions;
3. A domestic airline flight under unpredictable adverse convective weather and;
4. A domestic private GA flight under VMC conditions and operating on-demand (an unscheduled flight).

These use case scenarios are not intended to prescribe software, hardware solutions or interface design requirements, but rather highlight how AAtS can be used through all phases of flight and under various meteorological conditions by a variety of flight operators (i.e.: commercial, business, GA) to identify possible benefits of AAtS use and implementation to NAS users and operations. These use case scenarios could also be used to promote issues and raise questions for discussion, further analysis and research, such as:

- Human factors concerns
- Required bandwidth
- Timing of AAtS delivery of data/information.

Actors:

The actors are the human system users. Not all of the Use Cases will involve the same set of actors. The actors are defined in Table 6. System and Human Component Roles and Responsibilities are listed below.

TABLE 6 SYSTEM AND HUMAN COMPONENT ROLES AND RESPONSIBILITES

Actors	Roles and Responsibilities

Human	
Flight crew; captain and first officer	Primary recipients and users of NAS information
AOC/FOC; dispatcher, ATC coordinator and AOC manager	Authorize and coordinate changes to flight plans
CPCs from ATCT, TRACON and ARTCC	Control airspace operations, Traffic flow management
Traffic Flow Managers	Evaluate the NAS environment. Manage traffic flows and airspace usage
ANSP	Data source serving aeronautical and weather information

Interdependent/Auxiliary System Components

The products and services AAtS are proposed to involve in the near-term and/or far-term time frame that the scenarios will involve are defined in the table below.

TABLE 7 SYSTEM COMPONENTS/SERVICES AND FUNCTIONS

System Components/Services	Functions
Electronic Flight Bag (EDD)	Request, receive, acknowledge receipt, configure, subscribe, notifies, publish
Two-way radios	Communicate with controllers and company personnel
Mode-C transponders	Transmits a discrete 4-digit code identifying the aircraft to air traffic control
ADS-B	Transmits aircraft information/data
Data Communications / Data Link	Transmits data/information that may impact the trajectory of the flight
FIM	Flight Deck-based Interval Management. A collaborative tool for ATM and flight crews to jointly manage inter-aircraft spacing

GIM	Ground-based Interval Management. Ground-based functions to manage aircraft spacing.
FMS	Provides flight information and control to equipped aircraft
PBN	Performance-based Navigation. Routing based on aircraft capability.
RNAV/RNP	Provides flight guidance to equipped aircraft
TDWR	Provides high-quality radar data
ADDS	Provides text, digital and graphical forecasts, analyses, and observations of aviation-related weather variables
NNEW / 4 –Dimensional Weather Data Cube	Integrates weather information to provide a common weather picture
CIWS	Provides VIL and echo-top data
ITWS	Provides weather information
D-ATIS	Provides terminal information
ASOS	Provides airport surface condition information
DMS	Provides capability to manage data available from SWIM
TCP/IP network connection	Provides network access
VPN	Provides a secure tunnel to the appropriate network

Appendix E.1 - Use Case 1: Transcontinental Airline operating under normal conditions (LAX to JFK under VMC)

Purpose:

This use case will explore the attributes of AAtS capabilities and services under normal conditions with no expected impact. The goal is to identify benefits derived from on-demand NAS information throughout all phases of flight. It will also explore contextual flight information exchanges and detail common situational awareness between the flight crew/aircraft and the NAS

by providing the flight crew with descriptions of the overall traffic demand and/or activity in surrounding airspace.

Goal(s):

The goal of this use case scenario is to demonstrate common situational awareness between the flight crew, AOC and ANSP by the flight crew's access to AAtS SWIM provided information during normal operations.

Scenario background description:

FS1 is a fully loaded B767 commercial airliner scheduled for a transcontinental flight departing Los Angeles International Airport (LAX) at 1645Z for John F. Kennedy International Airport (JFK) a 5 hours and 16 minutes flight. The filed route is SAC J32 FMG J94 OBK J94 PMM J70 LVZ LENDY5 with a filed cruise altitude of FL310. The flight is expected to operate through the following ARTCCs: Denver (ZDV)/ Minneapolis (ZMP)/ Chicago (ZAU)/ Cleveland (ZOB) and New York (ZNY). LAX terminal airspace is currently operating under Visual Meteorological Conditions (VMC), and no weather impacts to the filed route are expected. JFK is also operating under VMC, and the surrounding airspace is expected to remain in VMC.

The arrival runway at JFK is currently undergoing repair; however, it is expected to complete before the international (arrival or departure) traffic becomes a factor with no impact on normal demand. There is concern that the runway will not reopen as scheduled; if that becomes the case, airport capacity will be impacted resulting in delays. Route and MIT restrictions are in effect for all flights into ZNY during the afternoon peak traffic demand. The normal afternoon traffic volume at JFK is currently at capacity. The flight is not expected to be impacted by any problematic events in the NAS.

Flight Planning

1615Z Flight crew carries out the pre-flight briefing, which includes reviewing the current weather and airport conditions for LAX terminal, en route, and JFK

After the flight crew receives the Clearance Brief from flight operations. Once onboard the aircraft, the flight crew configures the Electronic Display Device (EDD) to automatically retrieve updates for relevant flight information this includes updates to the operational plan for ZNY/New York TRACON (N90) or JFK that may occur including JFK airport surface

conditions. The flight crew also configures the EDD for convective weather, wind information or forecasted weather that may affect the planned route and altitude.

The flight crew reviews the ATCSCC OIS page for current departure delays out of LAX and the current operational plan for any potential system impacts en route, delays, or possible reroutes. The operational plan also provides current wind routes for JFK. The pilots compare the wind routes to the filed route to ensure that the planned route conforms to the wind routes. The pilot also checks for any traffic management initiatives (TMIs) in effect at JFK such as airborne holding, ground delay programs (GDPs), or ground stops (GSs).

Push Back / Taxi (Ground Movement)

1640Z the aircraft pushes back from the gate to taxi to their assigned departure runway.

Pilot request pushback and taxi clearance from the ATCT, the pilot taxis to the departure runway. Once at the end of the departure runway, the pilot contacts the tower for takeoff clearance.

Takeoff / Climb

1655Z the aircraft takes off.

ATC issues takeoff clearance and the aircraft rolls down the departure runway, takes-off and commences initial climb. Flight crew passes PIREP on tops on departure frequency at 2500 ft. ATC instructs the pilot to contact departure control without incident, and reaches cruising altitude 15 minutes later.

Domestic En Route Cruise

1810Z Moderate turbulence has been reported at FL310 along the route.

The EDD notifies the flight deck of PIREPs for moderate turbulence along the current route of flight at their altitude. The pilot enters a request into the EDD to display turbulence information for altitudes above and below their current altitude. From this, the pilot is informed of less turbulence at two thousand feet above their current altitude. Given this information, the pilot- request FL330 from ZDV and are given their requested altitude before they encounter the area of turbulence.

Descent / Arrival

2100Z Arrival Runway reopens

The flight deck receives notification on the EDD of a recent change to a previously published NOTAM. The NOTAM for JFK runway closure has been canceled and runway has reopened as scheduled.

The pilot then commences the Arrival Brief, which reviews the D-ATIS for current weather and wind information, and approach/ runways in use. The crew briefs planned approach procedure, fuel status, terrain, GPWS/TCAS alerts, altitudes speeds, crosswinds, and runway exit plan after landing.

The pilot receives clearance from TRACON (N90) approach control and the flight begins its arrival phase.

Final Approach / Landing

2145Z Taxiway Alpha has been closed between Taxiway November and Taxiway Lima due to a disabled aircraft resulting in +15 minute arrival delays into JFK

Flight deck receives notification for updated information on the OIS page and a newly published NOTAM for JFK. The pilot is now informed of taxiway Alpha closure between taxiway November and taxiway Lima due to a disabled aircraft. At this time, it is unknown when the taxiway will reopen.

2225Z +15 minute arrival delays into JFK

The flight receives holding instructions and EFC 2250Z into JFK due to the taxiway Alpha closure.

2235Z the flight crew receives current traffic flow, weather, and airport information for JFK.

Approximately 30 minutes from arrival at JFK, the flight crew checks the OIS page and learns that arrivals into JFK are presently incurring delays that are averaging 15 minutes. At this time, a NOTAM indicating that “taxiway Alpha is still closed” is received. The flight crew receives updates on airport conditions, current active runways and approaches in use. The flight deck also receives information on current weather conditions in N90 terminal airspace.

2305Z aircraft lands

Aircraft lands on time at JFK.

Table 8 Use Case Scenario1 Operational Comparison below provides a side-by-side comparison of operations today given this scenario compared to AAtS operations to highlight proposed benefits.

TABLE 8 USE CASE SCENARIO 1 OPERATIONAL COMPARISON

	Without AAtS	With AAtS
	1615Z ***Flight crew carries out the Clearance Brief*** Flight crew carries out the Clearance Brief	**1615Z** ***Flight crew carries out the Clearance Brief*** Flight crew carries out the Clearance Brief The pilot configures the EDD to trigger the retrieval of relevant information for any updates for LAX/JFK or airspace along there route of flight **1615Z**, the pilot configures the EDD to deliver 1- hour weather information/convective forecast updates for the en route airspace along the filed route of flight. This information is received and displayed to the pilot, which shows favorable weather and winds along the filed route The pilot enters a request on the EDD to retrieve and display information on JFK, including detailed aeronautical information such as approaches. The forecasted weather events displayed on the EDD show no significant weather at JFK The pilots review the ATCSCC OIS page for current

		departure delays out of LAX and the current operational plan for any potential system impacts en route, delays, and reroutes. The operational plan provides current wind routes for JFK; the pilots compare these wind routes to the filed route to ensure that the planned route conforms to the wind routes. The pilots also check for traffic management initiatives (TMIs) in effect at JFK such as airborne holding, ground delay programs (GDPs), and ground stops (GSs) The pilot checks the EDD for upper winds information they have received. The pilot configures the EDDs to indicate updates to the operational plans for JFK/New York TRACON (N90) and ZNY that may occur and real time updates
Takeoff / Climb	**1640Z** ***The aircraft pushes back from the gate to taxi to their assigned departure runway*** At 1640Z, the pilots taxi the aircraft for departure after receiving clearance from ATCT Once at the end of the runway, the pilot contacts the tower for departure clearance **1655Z**	**1640Z** ***The aircraft pushes back from the gate to taxi to their assigned departure runway*** At 1640Z, the pilots taxi the aircraft for departure after receiving clearance from ATCT Once at the end of the runway, the pilot contacts the tower for departure clearance **1655Z**

	The aircraft takes off **1655Z**, the aircraft departures and then commences initial climb. After departure the tower instructs the pilot to contact departure control. The aircraft then takes off and departs LAX terminal airspace without incident, and then reaches cruising altitude 15 minutes later	***The aircraft takes off*** **1655Z,** the aircraft departures and then commences initial climb. After departure the tower instructs the pilot to contact departure control. The aircraft then takes off and departs LAX terminal airspace without incident, and then reaches cruising altitude 15 minutes later
Domestic En Route Cruise	**1835Z** A/C encounters moderate turbulence at FL310. Pilot asks ZDV for any PIREPS they have for turbulence in the area and if they know of any better rides. ZDV asks for a ride report from a flight at the same altitude east of the A/C, reports same type turbulence. ZDV then request from A/C above and below the flights current altitude **1852Z** ATC advises the flight that FL330 has been reported as smooth, pilot request FL330. (Not having access to AAtS data required 17 minutes and a number of ATC transmissions to find smooth air	**1810Z** The EDD notifies the flight deck of recent PIREPS of moderate turbulence along there route their current altitude, FL310 as they enter ZDV. The pilot enters a request into the EDD for turbulence information at altitudes above and below their current altitude. From this, the pilots are aware of less turbulence at FL330. Given this information, the pilots request a higher altitude from ZDV and are given their requested altitude before they encounter the area of turbulence
Descent / Arrival	**2115Z** ***JFK runway reopened*** At 2115Z, the pilot contacts	**2100Z** ***JFK runway reopened*** The EDDs indicate the receipt of a recent change to

	ATC for NOTAM updates and ATIS information. The flight crew is informed by N90 that the NOTAM for JFK has been canceled The pilots also review the ATIS for current weather and wind information, and runways in use, altitude speed, crosswinds, and exits they should expect to take after landing	a previously published NOTAM for JFK. The flight deck receives notification the NOTAM for JFK has been cancelled and the runway has reopened. The pilot checks D-ATIS information and plan for descent and arrival into JFK The pilots also review the D-ATIS for current weather and wind information, and runways in use, altitude speed, crosswinds, and exits they should expect to take after landing
Final Approac h / Landing	**2145Z** ***Taxiway Alpha has been closed between Runway November and Runway Lima due to a disabled aircraft resulting in +15 minute arrival delays into JFK*** ***Flight deck is unaware of taxiway closure*** **2225Z** ***+15 minute arrival delays into JFK*** N90 issues airborne holding with EFC of 2255Z (Flight crew was unaware of the taxiway closure and possible delays) (Contacts dispatcher to find out the reason for delay and how long it may last)	**2145Z** ***Taxiway Alpha has been closed between Taxiway November and Taxiway Lima due to a disabled aircraft. Delays expected to be +15 minute range*** Flight crew receives notification on the EDD for a new published NOTAM for JFK. NOTAM for taxiway Alpha closure between taxiway November and taxiway Lima due to a disabled aircraft. Flight deck notified of possible arrival delays of +15 minutes. **2225Z** ***+15 minute arrival delays into JFK*** N90 issues airborne holding with EFC of 2255Z (From the information provided by the EDD flight crew was expecting the delay)

	2245Z ***The flight crew receives current weather for JFK*** 2245Z, in range, the flight crew checks ATIS for current weather and airport information. They receive information on taxiway closure **2305Z** ***The aircraft lands on time*** **2325Z,** the aircraft lands on time at JFK.	**2245Z** ***The flight crew receives current traffic flow, weather, and airport information for JFK*** At 2245Z, approximately 30 minutes from arrival at JFK, the flight crew checks the EDD and learns that arrivals into JFK are presently delayed for an average of 15 minutes. Checks ATIS for current weather and airport information and receive information on the taxiway closure **2305Z** ***The aircraft lands on time*** **2325Z,** the aircraft lands on time at JFK.

Demonstrated impacts from AAtS implementation:

- **Reduces impact on current system through increased situational awareness.**
  - Updated winds aloft and turbulence information supplied by AAtS allowed the flight crew to anticipate turbulence and request another altitude.
    - Reduced frequency congestion by using an alternate source of information other than a radio transmission.
  - Additional sources of weather information facilitated more accurate assessment of weather severity without requesting more information over the radio.
    - Reduced frequency congestion.
    - Shortened flight time and fuel usage by avoiding a needless deviation from the filed route.
  - Using AAtS to access runway in use and taxiway status at JFK reduces the need to gather information over the radio, reducing

frequency congestion and increasing cockpit safety by reducing last minute planning and adjustments.
  - These benefits all result from increased situational awareness.

- **AAtS implementation reduces system delays, allows flight crews to anticipate problems and provides sufficient time to design workarounds.**
  - Advanced information on turbulence at the flight's requested altitude allowed the crew to find an alternate altitude and avoid the reported turbulence.
    - The aircraft saved the fuel expended to reach the higher altitude, avoided the stress on the airframe and eliminated an unpleasant experience for the passengers.
  - Additional weather information beyond what is available to flight crews now allowed them to assess the weather as less severe than represented on their onboard radar system and available pilot reports.
    - The flight crew was able to make a decision using more information and sufficiently ahead of reaching the weather to make a reasoned judgment.
    - Avoiding deviations around weather reduced system complexity and possible system delays resulting from increased complexity.
  - NOTAMS automatically routed to the aircraft EDD notified the crew of runway and taxiway status and of delays so that they could judge the severity of congestion at their destination before their clearance to hold was delivered.

- **Increases information exchange between flight crews and air traffic control, providing real-time information to flight crews; alleviating unnecessary radio transmissions**
  - Information provided on weather, NOTAMS, D-ATIS and turbulence reports facilitated timely decision-making and obviated the need to solicit information on the radio.
    - Positive effect for the flight crew and the quality of the flight for passengers through more complete information than is presently available.

- Timely delivery of additional information allowed sufficient time for the flight crew to assess conditions and make more accurate and satisfactory choices.

Appendix E.2 - Use Case 2: Airline operating under normal conditions (ORD to IAD Commercial Flight IFR Flight, Snow at both Airports)

Purpose:

This use case will explore the use of AAtS capabilities and services under adverse but forecasted weather conditions. The goal is to identify benefits derived from on-demand NAS information throughout all phases of flight. It will also explore flight information exchanges within a given context and detail common situational awareness between the flight crew/aircraft and the NAS created by providing the flight crew with descriptions of the overall traffic demand and/or activity in surrounding airspace.

Goal(s):

The goal of this use case is it to demonstrate common situational awareness between the flight crew, AOC and ANSP by flight crew’s access to AAtS provided information. Greater awareness of operations and events as they are occurring can support pilots and airlines in ensuring safety, while making the most time and cost efficient flight operations possible.

Scenario background description:

Flight is operating from Chicago O'Hare International Airport (ORD) to Washington Dulles International Airport (IAD) both airports are impacted by snow. Snow removal is expected to be a factor at one or both airports with RWY closures and GDP/GS possible. Aircraft de-icing is underway at ORD and the airport arrival rate (AAR) and airport departure rate (ADR) are reduced. This scenario’s aim is to show the benefit of AAtS on flight operations, specifically the benefits during a snow event. Normally these irregular operations are known well in advance of the event and well planned by the ANSP, the Airport Authorities and the users and the ability of their flight operations department to adjust their schedule. Normally unknown in these irregular operations is the level of impact to the airport and snow removal considerations.

FS1 is a fully loaded B767 commercial airliner scheduled Chicago O'Hare International Airport (ORD) to Washington Dulles International Airport

(IAD) a 2 hour 35 minute flight. Filed route is KORD EARND ELANR EMMLY ERECO IIU J8 HVQ SHNON2 KIAD with a filed cruise altitude of FL310. ORD terminal airspace is currently operating under instrument flight rules (IFR) with low ceilings, visibility with snow impacting operations. IAD terminal airspace is also currently operating under instrument flight rules (IFR) with low ceilings, visibility with snow impacting operations.

<u>Flight Planning</u>

1510Z Flight crew carries out the pre-flight briefing, which includes reviewing the current weather and airport conditions for ORD terminal, en route, and IAD

After the flight crew carries out the Clearance Brief, the pilot configures the EDD to automatically retrieve updates for relevant flight information. The flight crew enters a request via the EDD for ORD and IAD for wind information and forecasted weather that may affect the planned route and altitude. This information is received and displayed to the pilot, which shows snow impacting both airports throughout the day.

The flight crew reviews the EDD for current departure delays out of ORD and the current operational plan for any potential system impacts en route, delays, or possible reroutes. The operational plan expects snow to impact arrivals for IAD, due to snow removal and runway closures, expecting ground a delay program for arrivals 1700z and later.

The flight crews configures the EDDs to indicate updates to the operational plan for ORD/C90/ZAU/ZDC/PCT/IAD and are expecting updates for ORD and IAD due to the conditions at the airports.

1525Z the aircraft still at the gate flight crew accesses weather.

The AOC advises the flight crew of a GDP for IAD EDCT is 1700Z. The flight crew plans to taxi out to start aircraft deicing to meet 1700Z EDCT.

1600Z Push Back / Taxi (Ground Movement)

Flight crew is cleared by Ramp Control to push back from the gate and taxi to the deicing pad. Once at the deicing pad, the engines are shut down, with the APU running, and deicing commences. To increase the holdover time, especially at ORD, the Captain elects to start with Type I glycol mix and supplement with Type IV.

At 1630Z Deicing complete, with holdover times good until 1715Z (Type I and Type IV glycol). The flight crew receives taxi instructions and runway

assignment. The flight crew restarts engines, taxis as instructed, holds short of active runway and switches to local (ATCT) and waits for takeoff clearance.

<u>Takeoff / Climb</u>

1655Z the aircraft takes off.

Flight crew receives take off clearance from the local (ATCT) controller and start its takeoff roll, flight takes off and commences initial climb. Local controller instructs the flight crew to contact departure control (C90) without incident, and reaches cruising altitude 15 minutes later.

<u>Domestic En Route Cruise</u>

1730Z Moderate turbulence has been reported at the current altitude along the route.

The flight crew is notified by the EDD of PIREPs for moderate turbulence along the current route of flight at their altitude. The flight crew checks the EDD for turbulence at alternate altitudes for better ride reports, EDD shows turbulence at most altitudes, but only a small area around Louisville, KY VOR (IIU). Based on this information the flight crew does not request altitude change but advises the flight attendants and passenger cabin of possible turbulence.

1805Z Update on en route holding for snow removal at IAD.

At 1805Z, the flight crew is notified by EDD, on airborne holding +15 minutes, which may reach +20 minutes, and that Runway 1L will close at 19Z for snow removal and will be completed on time at 2000z.

At 1930Z, the flight crew is issued airborne holding instructions from ZDC at FINKS, with an EFC of 2015Z.

At 1945Z, the EDD notifies the flight crew that runway 1L will open at 1955Z and that airborne holding is +15 minutes, but should start to decrease.

1955Z runway 1L open, the flight crew receives notification on the EDD of a recent change to a previously published NOTAM. The NOTAM for IAD runway closure has been canceled and Runway 1L has reopened.

The flight crew reviews the D-ATIS for current weather and wind information and commences to perform the Approach Brief approach/

runways in use. The pilot briefs planned altitudes speeds, crosswinds, and runway exit plan after landing.

At 1958Z, the flight is cleared out of holding and continues route to IAD.

Descent / Arrival

The flight crew receives clearance from Potomac TRACON (PCT) approach control for the approach.

Final Approach / Landing

At 2015Z the aircraft lands at IAD and taxis to the gate.

Table 9 Use Case Scenario 2 Operational Comparison below provides a side-by-side comparison of operations given this scenario compared to AAtS operations to highlight the proposed capability benefits.

TABLE 9 USE CASE SCENARIO 2 OPERATIONAL COMPARISON

	Without AAtS	With AAtS
	1510Z Flight crew carries out the Clearance Brief Flight crew carries out the Clearance Brief	***1510Z Flight crew carries out the Clearance Brief*** Flight crew carries out the Clearance Brief Flight crew accesses the ORD airport information, for updates on deicing times, taxi times and current departure delays. The flight crew configures the EDD to trigger the retrieval of relevant information for any updates for ORD/IAD or airspace along their route of flight **1515Z**, the pilot configures the EDD to deliver 1- hour weather information/turbulence forecast updates for the en route airspace along the filed route of flight This information is received and displayed to the pilot,

		which shows favorable weather and winds along the filed route The pilot enters a request on the EDD to retrieve and display information on ORD/IAD, including detailed aeronautical information such as approaches. The forecast weather events displayed on the EDD show significant snow possible for ORD and IAD The flight crew reviews the EDD for current departure delays out of ORD and the current operational plan for any potential system impacts en route, delays, and reroutes. The operational plan for IAD has snow removal with runway closures, probable GDP; The crew also checks for TMIs in effect at IAD such as airborne holding and GSs The flight crew checks the EDD for upper winds information they have received. He/she configures the EDDs to indicate updates to the operational plans for ORD/ZAU/ZID/ZDC/PCT and IAD that may occur and any

	1525Z, the flight crew is contacted by AOC and notified of the IAD GDP advertised and their EDCT is 1700Z **1530Z,** the crew contacts AOC to find out what the reason for the GDP is. **1535Z,** the Dispatcher contacts the crew and reads ATCSCC advisory to them **1555Z** ATIS, ORD current weather conductions, 600 overcast, visibility 2 miles, light snow, ORD airport and runway configuration, also gives any special instructions, ORD is doing snow removal and de-icing. Departing 32 L/R AND braking action reported as fair, patchy snow and ice, runway 28 closed for snow removal.	real time updates. **1518Z** the flight crew is notified by the EDD of GDP for IAD, the flight crew checks their EDCT of 1700Z and reads ATCSCC advisory for GDP **1550Z,** flight crew, using the EDD, checks automated winter forecast display for snow bands moving through the Washington DC area. The two hour forecast displays light to moderate snow at times **1555Z** ATIS, ORD current weather conductions, 600 overcast, visibility two miles with light snow; the ORD airport and runway configuration and any special instructions. ORD is doing snow removal and de-icing. Departing 32 L/R; braking action reported as fair; patchy snow and ice; runway 28 closed for snow removal
Push back / Taxi (ground movement)	**1600Z,** FO contacts ramp control for push back and receives taxi approval and instructions to the deice pad.	**1600Z,** FO contacts ramp control for push back and receives taxi approval and instructions to the deice pad **1610Z**, using the EDD, flight crew checks current

	1630Z with deice complete, the flight crew contacts ground control for taxi clearance for departure	operational plan for IAD - Possible system impacts en route; expecting possible airborne holding due to snow removal and volume. **1630Z** with deice complete, flight crew contacts ground control for taxi clearance for departure
Takeoff / Climb	**1655Z,** the flight is cleared for takeoff and climbs out to cruise altitude	**1655Z,** the flight is cleared for takeoff and climbs out to cruise altitude
Domestic En Route Cruise	**1800Z**, the flight encounters turbulence in the area of IIU The Cabin Crew advises the flight deck that one of the cabin staff hurt their ankle. Captain suspends cabin service, turns on the seat belt sign, and returns everyone to their seat; including flight attendants. Flight crew contacts ATC requesting PIREPS on turbulence, controller contacts flights in the area	**1730Z**, the EDD notifies the flight crew of turbulence in the region around IIU The flight crew checks reports and finds that light chop is at all altitudes, but in a very isolated area. **1740Z,** prior to entering the suspected area of turbulence, the Captain advises the cabin crew and passengers of possible turbulence and that cabin service will be suspended until the suspected area of turbulence is clear. For everyone to take their seats – Lastly, the Captain turns on the fasten seat belt sign. **1800Z** Flight encounters turbulence in the area of IIU. **1805Z**, the EDD notifies flight crew of ZDC/PCT airborne holding for IAD +15 minutes now expected to reach +20. Airport Authority has posted Runway 1L to close at 1900Z to 2000Z for snow

	for feedback, controller asks three flights in the area, flight finds that turbulence is at most altitudes and should be over in a short time **1840Z** Flight deck has not felt or heard any updated reports for turbulence on the ATC freq. advises cab and restarts cab service **1930Z,** ZDC issues air borne holding at FINKS EFC 2015Z Flight crew questions controller about holding, the cause of it and whether he foresees the EFC being extended. Controller advises about runway closure and that he is not sure how long it will last. **1935Z** Flight deck contacts AOC on the holding, asks if they know anything more and what they should expect. AOC contacts ATCSCC for information on holding, ATCSCC contacts ZDC for an update. **1945Z**, light crew is advised by AOC that holding is expected to be in the 20 minute range **1948Z** flight cleared out of the hold	removal" **1840Z,** the anticipated area of turbulence materialized, was ridden out for approximately 20 minutes. The flight crew checked real time updates and concluded, after the chop subsided, to return cabin service. The Captain turned off the fasten seat belt sign. **1930Z,** ZDC issues air borne holding at FINKS EFC 2015Z **1945Z,** the EDD notifies the flight crew of information on the IAD - "Airport Authority updated opening time for runway to 1955Z." **1948Z,** the flight is cleared out of the hold

		1955Z, the EDD notifies flight crew that the NOTAM for IL is cancelled and the runway is open.
Descent / Arrival	**2000Z** transferred to PCT on decent into IAD	**2000Z,** flight is transferred to PCT on decent into IAD. The flight crew uses EDD to check winter storm forecast to see snow volume at this time and how it may impact visibility at the airport. Additional real time information that is gathered from the EDD is: current RVR, braking reports, checks RVR. Checks braking action reports for runway 1L reports form B757 good.
Final Approach / Landing	**2020Z** cleared to land **2025Z,** aircraft lands, the flight crew reports braking as GOOD, taxis clear of the runway and on to the gate.	**2020Z** cleared to land **2025Z,** aircraft lands, the flight crew reports braking as GOOD, taxis clear of the runway and on to the gate.

<u>Demonstrated impacts from AAtS implementation:</u>

- **Reduce impact on current system through increased situational awareness.**
    - Flight crew is able to get a clear picture of the situation along their route of flight before takeoff.
        - Crew can discuss possible alternatives to conditions along route.
        - They can consult company about suggested strategies.
        - The crew can anticipate air traffic control clearances in response to flight conditions.
    - Long before clearance into holding near destination airport the crew anticipates delays.
        - If necessary they can review published holding fixes.
        - Passengers can be advised of possible arrival delays.

        - They can review EDD for a clearer picture of airport conditions.
- **Reduce system delays, anticipate problems, and provide sufficient time to design workarounds.**
    - Through advance information provided by AAtS the flight crew can anticipate air traffic control programs.
        - Advanced distribution of the destination ground delay program allows the crew to research at what point in route the aircraft will enter a holding pattern.
            - Early flight crew awareness of destination events facilitates an orderly discussion of conditions to expect and investigation of alternatives if necessary
                - Extra time translates into a more complete knowledge of alternatives and a crew discussion of possible alternatives.
    - System delays are possibly reduced through an alternative of information to solicitation on frequency and less time required to explain the reason for delays on frequency.
        - Providing additional channels of information can reduce frequency congestion and so reduce air traffic complexity.
        - Orderly assessment of flight conditions by the crew facilitated by timely distribution of information raises the quality of crew decisions and shifts some of the burden of information delivery from air traffic control to AAtS.
- **Increase information exchange between flight crews and air traffic control, provide real-time information to flight crews, eventually reduce frequency congestion**
    - AAtS distributed vital information in this scenario directly to the crew that facilitated timely and orderly decision-making.
        - Access to this information reduced the need to solicit it from air traffic control.
        - When the flight crew made a decision, air traffic control would require a shorter explanation for the decision because they shared the same situational awareness.
        - The threat of frequency congestion is reduced through access to this information by a different communication channel.

- Air traffic control can target the most essential information to the flight crew when the requirement to deliver less essential information by radio is reduced.

Appendix E.3 - Use Case 3: Domestic Airline Flight (Severe Weather Event) unpredictable adverse convective weather event with potential reroutes.

Purpose:

This Use Case will explore the impact on situational awareness and collaborative decision making by providing pilots with real-time operational information pertinent to their flight in order to make more informed decisions. It will also explore other uses of AAtS during unpredictable convective weather events providing the flight deck with real or near real time weather presentations. This information along with routing options can allow the pilot to make a more informed decision. This Use Case scenario describes a fictional scenario in which a domestic airline flight approaches unpredictable, adverse convective weather events along the route of flight causing a potential for reroutes or a SWAP to take effect.

Goal(s):

The goal of this Use Case is to demonstrate common situational awareness between the flight crew; AOC and ANSP by the ability for flight crew's to access AAtS provided information. Greater awareness of operations and events as they are occurring can support pilots and airlines in ensuring safety, while making the most of time and enabling a cost efficient flight operation.

Scenario background description:

EA1427, Boeing 737 is a fully loaded commercial airliner scheduled for a domestic flight from San Francisco International Airport (SFO) at 1230Z bound for Chicago O'Hare International Airport (ORD) with an estimated time of arrival at 1640Z. The current METAR for SFO is KSFO 011156Z 00000KT 10SM OVC005 11/08 A3003 RMK AO2 SLP169 T01110078.The filed route is BCE J100 EKR BFF J94 DBQ JVL BULLZ1 and the flight is expected to operate through the following ARTCCs: ZLC/ZDV/ZMP/ZAU and C90. SFO terminal airspace is currently operating under IMC. SFO ground delay program for SFO arrival traffic is in effect but not impacting departure traffic. The current forecast predicts an area of convection along

the boundary between ZAU / ZKC/ZMP impacting ORD arrivals over the JVL and BDF arrival routes during the west arrival bank. ORD is not expecting the convection to reach the airport or impact the arrival rate. West departure routes will be impacted but west departure volume is light during this period and should not impact operations. A line of thunderstorms have been detected west of ORD, however, the current forecast cannot provide with high confidence the exact time of when these weather events will take place. Despite this, the aircraft plans to depart on a normal route. The current operational plan calls for ZMP/ZKC to trigger the re-routes.

Flight Planning

1130Z Flight crew carries out the pre-flight briefing, which includes reviewing the current weather and airport conditions for SFO and ORD terminal and en route

After the flight crew carries out the Clearance Brief the pilot configures the EDD to automatically retrieve any updated relevant flight information for departure, en route and destination.

The pilots review the ATCSCC OIS page for current departure delays out of SFO and the current operational plan for any potential system impacts en route, delays, and reroutes. Operational plan defines possible reroutes for ORD arrivals 1500z and later. The pilot configures the EDD to indicate updates to the operational plans for ORD/Chicago (C90) that may occur.

Push Back / Taxi (Ground Movement)

1200Z the aircraft pushes back from the gate to taxi to their assigned departure runway.

The pilot receives a more current ATIS (SFO is still IMC due to fog but this is not impacting operations) before requesting pushback and taxi clearance.

At 1220Z, the FO requests and receives a pushback from ramp control and taxi clearance from SFO ground control, taxis to the departure runway, and then contacts the tower (ATCT) for takeoff clearance. The flight departs on time.

Takeoff / Climb

1230Z the aircraft takes off.

At 1230Z, the aircraft takes off and climbs out without incident. The flight crew gives a PIREP to departure (NCT), “top of the fog layer is 3000ft clear above.”

Domestic En Route Cruise

1315Z Moderate turbulence reported in ZDV along most of the flight route

At 1245Z, the aircraft has reached cruising altitude. The flight crew receives a notification on the EDD of numerous reports indicating moderate clear air turbulence in ZDV along the route of flight. The pilot reviews EDD for reports on turbulence at other altitudes to see if they are able to get a better ride. The reports indicate FL350 has only light chop reported. The flight crew requests FL350 from ZDV, which they are given, and precede to climb through the rough air avoiding the moderate turbulence for the remainder of the flight.

1425Z Convective weather forecasted causing potential for reroutes for ORD west arrivals, playbook route may go into effect

Flight crew receives notification on the EDD indicating a new OPS Plan for ORD due to uncertainty of when convection will start. ZKC and/or ZMP will be the trigger for reroutes. The playbook route will be ORD JVL/BDF 2.

1455Z Playbook route ORD JVL/BDF 2 has been executed after the flight crew checks for an alternate route.

The flight crew opens the Playbook link on the OIS page and reviews the route. After this review, they contact Dispatch to ensure that they are able to accept the route ONL J114 GEP J106 GRB TVC WYNDE4. The Dispatcher advises the crew they have the sufficient fuel for the reroute. The crew pre-programs the FMS with the route and saves it until it is confirmed by ZMP.

The flight crew then configures the EDD to retrieve the convective weather forecast for ZMP/ZKC. This forecast is displayed and shows convective weather developing in the area of ONL extending south of BDF. Next, the crew reviews the receipt of a notification indicating playbook route JVL/BDF 2 playbook has been executed.

1515Z the pilots receive a reroute through clear weather.

ZDV clears the flight via two-way radio to give the direct route ONL FSD J114 GEP J106 GRB TVC WYNDE4. The flight crew configures the EDD to deliver weather updates and turbulence information for this new route, and is informed that the weather is currently clear along the trajectory with convective weather developing south of the route.

1605Z No convective weather but turbulence exists along the new route.

Flight crew receives notification on the EDD of turbulence along the new route. Upon review, it shows that for the remainder of the flight the aircraft will be experiencing turbulence. Before encountering turbulence, the flight crew instructs the cabin crew to cease cabin service and for everyone to remain seated for the remainder of flight.

Descent / Arrival

1630Z the flight crew receives NOTAMs and ATIS information.

The flight crew checks ATCSCC TCA page for an indication on ORD operations. With the high level of impact on C90 operations, the TCA page with comments and operational request – flight crews have are read only access to the TCA page.

- Weather data;
    - TAF and METAR for ORD, current weather VFR with no impact on the airport. TAF forecast good VFR conditions with the convection not impacting the airport until late evening.
    - D-ATIS for current airport weather for ORD arrivals includes approach in use, visual to 27R|27L|28. NOTE: flight is still outside range to receive broadcast AITS.
    - Flight crew reviews CIWS to see if the convection forecast has changed; - no changes were seen in the area forecast from earlier to now.
- OIS;
    - Flight crew reviews all the current re-routes for ORD to get an understanding of the total impact, (this will enable the flight crew to understand that some of the re-routes are to handle sector volume problems)

Currently no arrival delays for ORD on the TCA page. ZAU expects arrivals delays in the +30 minute range

AAtS ORD arrival notifies flight deck that ZAU expects arrival delays to be +30 minutes. Flight crew and AOC revise the arrival time from the re-route and possible holding. A gate time of 15 minutes late is now expected and this information is PA communicated to the cabin.

1655Z the flight deck receives an indication for updated information on the OIS page and a newly published NOTAM for ORD.

1700Z the flight deck receives current traffic flow, weather, and aeronautical information for ORD.

<u>Final Approach / Landing</u>

1720Z the aircraft lands at ORD and taxis to the open gate.

Table 10 Use Case Scenario 3 Operational Comparison below provides a side-by-side comparison of operations today given this scenario compared to AAtS operations to highlight proposed benefits.

TABLE 10 USE CASE SCENARIO 3 OPERATIONAL COMPARISON

	Without AAtS	With AAtS
Flight Planning	***1130Z*** ***Flight crew carries out the Clearance Brief*** Flight crew carries out the Clearance Brief, also includes convective forecast for the area in ZKC/ZMP/ZAU with the possible development and reroutes for ORD arrivals.	***1130Z*** ***Flight crew carries out the Clearance Brief*** Flight crew carries out the Clearance Brief, also includes convective forecast for the area in ZKC/ZMP/ZAU with the possible development and reroutes for ORD arrivals. The flight crew configures the EDD to trigger the retrieval of relevant information for any updates for SFO/ORD or airspace along the route of flight. **1115Z**, the flight crew configures the EDD to deliver weather information/convective forecast updates for the en route airspace along the filed route of flight. Current information displayed to the flight crew displays convective weather possibly impacting ZKC/ZMP arrival routes into ORD.

		The flight crew enters a request on the EDD to retrieve and display information on ORD, including detailed aeronautical information such as approaches. The flight crew reviews the EDD for current departure delays out of SFO and the current operational plan for any potential system impacts en route, delays, and reroutes. The operational plan has probable reroutes for ORD arrival traffic over BDF and JVL 1630Z and later. ZKC/ZMP will trigger the reroutes based on the development and impact of the convection. The flight crew configures the EDDs to indicate updates to the operational plans for ORD/C90 and ZAU that may occur and real time updates.
Push back / Taxi (ground movement)	***1200Z*** Pilot contacts ramp control for push back and ramp movement. Once clear of the ramp pilot contacts ground control for taxi clearance.	***1200Z*** Pilot contacts ramp control for push back and ramp movement. Once clear of the ramp, pilot contacts ground control for taxi clearance.
Takeoff / Climb	***1230Z*** Aircraft departs SFO and climbs out, clears tops at 3000 feet. FO passes PIREP to ATC on tops.[7]	***1230Z*** Aircraft departs SFO and climbs out, clears tops at 3000 feet. FO enters PIREP in EDD on the tops during climb out.
Domestic En Route Cruise		***1315Z*** Flight crew is notified by the EDD of reported turbulence in ZDV airspace. Pilot checks

	1345Z Flight crew hears questions on turbulence on the frequency entering ZDV between aircraft and controller. Pilot waits until there is break in the frequency and asks for a report on the turbulence and is informed it is at their altitude and direction. Pilot asks for reports of a better ride. Captain advises the cabin of possible turbulence and has the cabin crew stop all services. As the flight crew waits for the controller to get reports in the area, it ties up the frequency and takes time. The aircraft has now entered the area of turbulence; cabin crew is still working to clear the cabin, get the carts stowed and get everyone back in their seats. After 10 minutes ZDV advises the flight crew that FL350 reports only light turbulence and ask if the flight would like higher, crew confirms the request, ZDV clears the aircraft to FL350. Cabin crew reports to the Captain that one passenger and one of the cabin crew were hurt slightly in the turbulence.	the reported turbulence and finds turbulence is reported is confined to an area 150 miles ahead at their altitude and below for 100 miles. Ask ATC and receives higher altitude. ***1430Z*** Flight crew checks the convective forecast for weather development in ZKC/ZMP. Based on the operational plan the flight crew is looking for the development and possible reroute. Display is showing small areas starting to develop that may impact the routes. ***1450Z*** Flight crew notified on EDD ATCSCC sends advisory on thunderstorms starting to impact the BDF arrivals,

	1445Z The flight crew is checking storm scope but with limited range does not see the area forecasted to develop. ***1525Z*** ZMP clears flight to ORD via direct ONL J114 GEP J106 GRB TVC WYNDE4. The flight crew questions the controller concerning the reason for reroute. Unsure if they can accept the reroute, the flight crew needs to check with their dispatcher before they can accept route. ***1530Z*** The flight crew contacts the	expects to be closed off for most arrivals ***1455Z*** Flight crew reviews routes listed in the ATCSCC Operational plan and impact on flight, also checks with the dispatcher. ***1500Z*** Flight crew notified by EDD, ATCSCC route advisory for ORD arrivals being develop ***1515Z*** EDD notifies the flight crew of change to ORD. Flight crew checks the changes; route advisory for ORD has been published. Flight crew can expect ONL J114 GEP

	dispatcher with questions about the reroute. The dispatcher relays information on the reroute and the weather development along the reroute to the flight crew.	J106 GRB TVC WYNDE4 reroute, based on planning with the dispatcher from the ATCSCC advisories; flight crew can accept the route. This will add 20 minutes of flying time and approximately 920 LBS of fuel. ***1525Z*** ZMP clears flight to ORD via direct ONL J114 GEP J106 GRB TVC WYNDE4. Pilot accepts clearance and programs the FMS, then checks the EDD for weather and flight conditions along the reroute. ***1535Z*** The dispatcher has checked all passenger connections and relays this to the flight crew. The late arrival will not impact the connections.
	1537Z The dispatcher advises the flight crew they can accept the reroute and that their fuel load is fine. ***1542Z*** Flight Crew advises ZMP that they can accept the reroute. Due to the delay in accepting the reroute, the flight has added an additional 17 minutes to the flight and approximately 800 LBS of fuel. The total cost of the reroute 37 minutes and 1720 LBS of fuel, compared to AAtS flights 20 minute and 920 LBS of fuel. ***1550Z***	

	Flight crew requests an updated weather forecast along the new route of flight. ***1558Z*** Dispatcher sends flight crew the updated forecast, not expecting any weather along route. ***1600Z*** Dispatcher advises pilot the flight is going to be APRX 40 minutes late and passes along information on gate information on for passengers with connections.	
Descent / Arrival	***1700Z*** Flight starts decent into ORD in VFR conditions.	***1640Z*** Flight starts decent into ORD in VFR conditions.
Approach / Landing	***1720Z*** Flight lands, +20 minutes late and taxis to the still open gate.	***1700Z*** Flight lands and taxis to the still open gate.

<u>Demonstrated impacts from AAtS implementation:</u>

- **Reduce impact on current system through increased situational awareness.**
  - Use of AAtS-delivered data dramatically increased the flight crew's situational awareness.
    - Learned before departure of possible reroutes into O'Hare.
    - While en route the crew was notified to clear air turbulence in Denver Center airspace.
    - Anticipated playbook reroute long before ATC cleared them on new route to destination.
    - Had access to new route prior to clearance.

    - Planned for possible reroute with their AOC, made easier because of their shared situational awareness.
    - EDD informed the crew of delays into destination airport prior to notification by radio from ATC.
  - Increased situational awareness reduced impact on the NAS.
    - Anticipated CAT and requested altitude change before encountering turbulence.
      - Eliminated the need for a conversation with ATC of turbulence.
      - Prevented an urgent request for solicitation of pilot reports of turbulence and the resulting rushed request for an immediate altitude change.
    - A delay in accepting a reroute was prevented through a planning discussion with their AOC on the plane's capability to fly the new routing to destination.
      - ATC wasn't put on hold while the flight crew consulted with the AOC.
  - ATC could issue the flight plan, receive immediate acceptance of the new route.
    - Impact of the reroute on the system reduced through this exchange made efficient because of a raised situational awareness held by the affected flight crew.
    - An on-frequency conversation about weather conditions on new route is avoided.
    - Immediate request of turbulence reports and possible rerouting is not necessary because the crew possessed the information on flight conditions in sufficient time to research the weather and assess its impact on their flight.
- Reduce system delays, anticipate problems, and provide sufficient time to design workarounds.
  - System delays were reduced by advanced information provided by AAtS.
    - The flight crew knew about the reroute plan and prepared for it, reducing the time necessary for ATC to first explain and then issue the reroute clearance.
    - Anticipating the reroute allowed the crew to coordinate with their AOC and thus eliminate a delay between the reroute issuance and acceptance by the flight crew.

        - No conversation of conditions along the new route is necessary since the AAtS-provided weather information was sufficient to have a clear picture of flight conditions.
    - No surprises were encountered along the route despite complex weather and traffic conditions.
        - Information provided in time sufficient to judge the severity of conditions and assess necessary responses to these conditions led to an orderly and effective decision-making process for the flight crew.
            - The result was a crew with enough information delivered early enough to advise passengers, their AOC, and ATC of both what was to be experienced and to design workarounds.
- Increase information exchange between flight crews and air traffic control, provide real-time information to flight crews, and eventually reduce frequency congestion.
    - The information exchange between ATC and the flight crew was made more efficient and effective.
        - The crew anticipated ATC clearances in response to flight conditions, lessening the chance for misunderstanding, questioning the need for reroutes or altitude changes, or the threat of missed information.
        - ATC is less likely to have to repeat clearances or for communication to be misunderstood
            - The flight crew already knows the context of the communication.
        - ATC can concentrate on essential information.
            - AAtS delivery of information via a non-essential channel frees ATC to focus more on essential information.
        - Frequency congestion is reduced.
            - As AAtS diverts non-essential information to an alternative communication channel, ATC may need to deliver less but more essential information via the radio, lessening the risk of frequency congestion.
    - Increased information exchange provides the flight crew with a context to information delivered by radio.
        - Context lessens the threat of misunderstanding information.

- A shared context can shorten messages, allowing more messages to be broadcast.
- A shared context provides the means for a more collaborative environment

Appendix E.4 - Use Case 4: Domestic Private Jet General Aviation (GA) On-demand (unscheduled) flight operating under unpredictable weather conditions.

Special events, such as the super bowl, can instigate an increase in demand at surrounding airports where the event is scheduled to occur. This can create airport surface and terminal congestion, most of which is an increase in unscheduled GA traffic. This use case scenario presents a general aviation flight with no Flight Operations Center (FOC) support. It relies solely on airborne support called “flight following, provided by a Flight Service Station (FSS). With near real-time presentation of airport demand information, companies and airlines can plan their flights to the general destination more efficiently.

Purpose:

This use case will explore the use of AAtS by a private aircraft operator who needs to operate multiple flights by a single aircraft into and out of a specific area where a special event is scheduled to take place. The use of AAtS by a GA pilot will be demonstrated while operating under IFR conditions throughout the flights without the benefit of support provided by an FOC.

Goal(s):

The goal of this use case it to demonstrate efficient and timely operations granted by airport and terminal information disseminated to users through AAtS enabled services. Another goal is to show support for common situational awareness between the flight crews, ATM and other NAS users created by access to descriptions of the overall traffic demand and/or activity in surrounding airspace that will contribute to collaborative decision making, enabling greater flexibility in flight operations. .

Scenario background description:

Cessna N220ND, C650 (Citation III) is a private company jet, of a medium sized business in the Chicago area, the flight department consists of two

pilots, the Captain and a co-pilot, one person is the complete office staff and a one person ground crew, who serves as the mechanic, ramp attendant and fueling aircraft. The company does not have the benefit of a scheduling department or an FOC. The company relies on a pay per use flight planning service that allows them to call in or use an online service to flight plan or make changes to future flight plans. The company's Citation will be making two trips from the Chicago area to Indianapolis (IND) for the Super Bowl to drop off passengers. The aircraft will be overnighting in the area and making return trips the following day. The flight crew has two Special Traffic Management Programs (STMP) requests for the flights into IND area. The flight crew has filed IFR flight plans for all legs for the day. The first flight's filed routing is ORD EON V399 KENLA V128 JELLS IND at an altitude of FL210. STMPs are needed to control the volume into IND area airports normally not seeing a great deal of volume. STMPs are for GA into the IND area and not set for a single airport. Normally scheduled airline traffic and flights based at the STMP airports are exempt from the program. Weather at IND may be a factor throughout the day and may require a ground delay program. Once the aircraft takes off, the only support the pilots have is provided by the FSS.

Route and MIT restrictions are in effect for all flights into Indianapolis Center (ZID) throughout the day in anticipation of increased traffic due to the Super Bowl event. The morning traffic volume at IND is expected to reach capacity within the next hour. The flight is not expecting to be impacted by any problematic events in the NAS. ATCSCC has established a position to manage Super Bowl operations. Special status board is established to maintain current information.

<u>Flight Planning</u>

1250Z Flight crew carries out the pre-flight briefing-which includes reviewing the current weather and airport conditions for PWK, en route and IND

The flight crew receives a weather briefing from FSS, confirms the IFR flight plans have been filed and there are no changes to departure time. The flight crew enters the aircraft an hour before departure. After the flight crew contacts the PWK Tower controller, the flight crew configures the EDD device to trigger the retrieval of any updates for IND and enters a request via the EDD for upper wind information and forecast weather that may

affect the planned route and requested altitude. The meteorological information is tailored to the flight trajectory and flight times and information is received and displayed to the flight crew showing favorable weather and winds along the filed route within the specific times that have been specified. The forecast weather events displayed on the EDD show IFR weather in the IND area that may impact all the airports. The flight crew then requests the EDD to retrieve and display detailed aeronautical information for IND including all instrument approaches.

The flight crew proceeds to review the EDD for current departure delays out of C90 and the current operational plan for any potential system impacts en route, delays, and reroutes and checks for traffic management initiatives (TMIs) in effect at IND.

With all pertinent flight information and updates reviewed and briefed, the flight crew contacts the ground control/clearance delivery at PWK and requests clearance to IND.

The flight's STMP time into IND is 1520Z the flight needs to be airborne by 1400Z to meet the STMP time into IND. Lastly; the flight crew configures the EDDs to indicate updates to the operational plans for C90/ZAU/ZID/IND that may occur.

Push Back / Taxi (Ground Movement)

1345Z the aircraft taxi to their assigned departure runway.

The flight crew contacts GC for taxi clearance, taxis the aircraft to the end of the runway and switches the frequency to Tower (ATCT) for takeoff clearance.

Takeoff / Climb

1355Z the aircraft takes off.

The flight is cleared for takeoff, the aircraft rolls down the departure runway and commences initial climb. Tower instructs the flight crew to contact departure control (C90); the aircraft departs C90 terminal airspace without incident and reaches cruising altitude 15 minutes later.

Domestic En Route Cruise

1420Z, the flight has reached cruising altitude of FL210 and EDD notification the flight crew that:

Airborne holding has just been initiated for arrivals into IND terminal airspace

The flight crew receives airborne holding instructions at JAKKS intersection with EFC 1440Z IND.

1425Z Flight crew is cleared out of holding to IND.

<u>Descent / Arrival</u>

1500Z Flight crew begins their descent into IND.

<u>Approach / Landing</u>

1520Z Flight lands, passengers disembark at the FBO and the flight crew programs the FMS and they perform their cockpit checks for the outbound leg.

<u>Return trip to RFD Flight Planning</u>

1545Z AAtS flight is at IND, flight plan is on file and pilots had pre-briefed on the inbound leg.

Non-AAtS contacts their flight planning service to amend the flight plan to depart from EYE instead of IND. Pilot contacts FSS to check NOTAMs for restrictions on departing from EYE.

<u>Push back / Taxi (ground movement)</u>

1600Z AAtS flight contacts Ground Control (GC) for taxi.

Non-AAtS contacts IND TRACON to request departure clearance; flight crew is given the clearance but told to hold for release for traffic – expect a 15 minute delay.

<u>Takeoff / Climb</u>

1615Z AAtS flight is airborne at altitude

Non-AAtS flight is taking the runway for departure

<u>Domestic En Route Cruise</u>

1720Z AAtS flight is notified by EDD of GAAP program at IND due to reduced Airport Arrival Rate (AAR) - average delay 35 minutes. The flight crew contacts FSS to see if their flight planned into EYE would incur a delay. Pilot contacts passengers at RFD to confirm what they required delay into IND or on time to EYE. Passengers request to go on time to EYE.

Non-AAtS flight is unaware of the GAAP program or its impact on the flight.

1730Z AAtS flight crew contacts the flight planning service to change the flight plan into EYE and contacts the limo service to meet the flight at EYE.

NOTE: the impact on the non-AAtS flight would continue to compound delays if scenario was continued

Table 11 Use Case Scenario 4 Operational Comparison below provides a side-by-side comparison of operations without AAtS, given this scenario, compared to a flight with AAtS operations to highlight proposed benefits.

TABLE 11 USE CASE SCENARIO OPERATIONAL COMPARISON

	Without AAtS	With AAtS
Flight Planning	**1250Z** - ***Flight crew carries out the Clearance Brief*** Flight crew carries out the Clearance Brief, also includes convective forecast for the area in ZKC/ZMP/ZAU with the possible development and reroutes for ORD arrivals.	**1250Z** - ***Flight crew carries out the Clearance Brief*** Flight crew carries out the Clearance Brief, also includes convective forecast for the area in ZKC/ZMP/ZAU with the possible development and reroutes for ORD arrivals. The pilot configures the EDD device information for C90/ZAU/ZID/IND
Push back / Taxi (ground movement)	**1345Z** flight taxi’s out for departure, STMP time into IND is 1520Z	**1345Z** flight taxi’s out for departure, STMP time into IND is 1520Z
Takeoff /	**1400Z** flight is airborne	**1400Z** flight is airborne

Climb		
Domestic En Route Cruise	**1420Z** flight is issued holding EFC 1500Z Flight crew starts looking at their time schedule. They have 60 minutes to do a quick turn to get back to RFD for the second group. Due to the schedule, the flight crew talks with the passengers and change their destination to EYE.	**1415Z** EDD notifies the flight crew of the airborne holding into IND; expected to be 15 to 20 minutes. The flight crew starts looking at their time schedule; they have 60 minutes to do a quick turn to get back to RFD for the second group. Holding up to 30 minutes will still allow the flight crew to make RFD in time for the return flight. **1420Z** – The flight crew is issued holding instructions with an EFC of 1500Z **1445Z** update on the EDD current airborne holding is only going to be +15; also because of reduced AAR the ATCSCC is planning to G/S into a GAAP program for IND
Descent / Arrival		**1446Z** – flight is cleared out of holding and continues to IND
Final Approach / Landing Flight Planning	**1455Z**-Flight lands at EYE, passengers have LIMO to IND to meet customers at FBO will be late for meeting **1510Z** – Flight crew contacts flight plan service to change their flight from IND to RFD to EYE departure to RFD **1545Z** - flight crew contacts FSS for weather briefing and update on current TMI's	**1500Z** Flight lands at IND without problem Limo waiting for passengers at FBO **1545Z** - Flight crew reviews EDD for current weather, TMI's and the Super Bowl status board for IND updates **1600Z** - GAAP program for

		IND expected to be out about 1615Z

Demonstrated impacts from AAtS implementation:

- **Reduce impact on current system through increased situational awareness.**
  - Use of AAtS-delivered data dramatically increased the flight crew's situational awareness.
    - Learned before departure of possible reroutes into O'Hare.
    - While en route the crew was notified to clear air turbulence in Denver Center airspace.
    - Anticipated playbook reroute long before ATC cleared them on new route to destination.
    - Had access to new route prior to clearance.
    - Planned for possible reroute with their AOC, made easier because of their shared situational awareness.
    - Super bowl status board informed the crew of delays into destination airport prior to notification by radio from ATC.
  - Increased situational awareness reduced impact on the NAS.
    - Anticipated CAT and requested altitude change before encountering turbulence.
      - Eliminated the need for a conversation with ATC of turbulence.
      - Prevented an urgent request for solicitation of pilot reports of turbulence and the resulting rushed request for an immediate altitude change.
    - A delay in accepting a reroute was prevented through a planning discussion with their AOC on the plane's capability to fly the new routing to destination.
      - ATC wasn't put on hold while the flight crew consulted with the AOC.
        - ATC could issue the flight plan, receive immediate acceptance of the new route.
    - Impact of the reroute on the system reduced through this exchange made efficient because of a raised situational awareness held by the affected flight crew.

        - An on-frequency conversation about weather conditions on new route is avoided.
        - Immediate request of turbulence reports and possible rerouting is not necessary because the crew possessed the information on flight conditions in sufficient time to research the weather and assess its impact on their **flight.**
- **Reduce system delays, anticipate problems and provide sufficient time to design workarounds.**
    - System delays were reduced by advanced information provided by AAtS.
        - The flight crew knew about the reroute plan and prepared for it, reducing the time necessary for ATC to first explain and then issue the reroute clearance.
        - Anticipating the reroute allowed the crew to coordinate with their AOC and thus eliminate a delay between the reroute issuance and acceptance by the flight crew.
        - No conversation of conditions along the new route is necessary since the AAtS-provided weather information was sufficient to have a clear picture of flight conditions.
    - No surprises were encountered along the route despite complex weather and traffic conditions.
        - Information provided in time sufficient to judge the severity of conditions and assess necessary responses to these conditions led to an orderly and effective decision-making process for the flight crew.
            - The result was a crew with enough information delivered early enough to advise passengers, their AOC, and ATC of both what was to be experienced and to design workarounds.

- **Increase information exchange between flight crews and air traffic control, provide real-time information to flight crews and reduce frequency congestion.**
    - The information exchange between ATC and the flight crew was made more efficient and effective.
        - The crew anticipated ATC clearances in response to flight conditions, lessening the chance for misunderstanding, questioning the need for a reroutes or altitude changes, or the threat of missed information.

        - ATC is less likely to have to repeat clearances or for communication to be misunderstood
            - The flight crew already knows the context of the communication.
        - ATC can concentrate on essential information.
            - AAtS delivery of information via a non-essential channel frees ATC to focus more on essential information.
        - Frequency congestion is reduced.
            - As AAtS diverts non-essential information to an alternative communication channel, ATC may need to deliver less but more essential information via the radio, lessening the risk of frequency congestion.
    - Increased information exchange provides the flight crew with a context to information delivered by radio.
        - Context lessens the threat of misunderstanding information.
        - A shared context can shorten messages, allowing more messages to be broadcast.
        - A shared context provides the means for a more collaborative environment.

APPENDIX F. CANDIDATE AATS DATA ELEMENTS

TABLE 12 CANDIDATE AATS DATA ELEMENTS

Data Category	Data Element (from Reference 4)	Domain or Source
F&FM	Advisories - TFM	TFM/ARTCC
F&FM	Airspace Capacity - TFM	TFM/ARTCC
F&FM	Aircraft Arrival Approach Assignment	TFM/ARTCC
F&FM	Aircraft Initial Planned Flight Rules	TFM/ARTCC
F&FM	Aircraft Arrival Sequence	TFM/ARTCC
F&FM	Aircraft Expect Departure Clearance Time (EDCT) Assignment	TFM/ARTCC
F&FM	Aircraft Flight Updates-En route (Departure/Cruise/Arrival)	TFM/ARTCC
F&FM	Aircraft Flight Lists-En route Demand	TFM/ARTCC
F&FM	Delays-En Route Arrival/Departure Delays	TFM/ARTCC
F&FM	Flight Operating Data source identification.	TFM/ARTCC
F&FM	Flight Plan Route (User Preferred)	TFM/ARTCC
F&FM	Flight Plan Route (User Preferred Alternatives)	TFM/ARTCC
F&FM	Flight Plan Route Constraint Evaluation (4D)	TFM/ARTCC
F&FM	Routes - En route Constraints	TFM/ARTCC
F&FM	Routes - FAA Preferred - Operational Information System (OIS)	TFM/ARTCC
F&FM	Routes - FAA Preferred - Route Management Tool (RMT)	TFM/ARTCC
F&FM	Routes - Available - Route Availability Planning Tool (RAPT)	TFM/ARTCC
F&FM	Routes - Closed - RAPT	TFM/ARTCC
T&FM	Routes - Constrained - RAPT	TFM/ARTCC
F&FM	Routes - Active Reroutes - RAPT	TFM/ARTCC
F&FM	Routes – Coded Departure Routes (CDRs)	TFM/ARTCC
F&FM	Routes - Playbook	TFM/ARTCC
F&FM	Routes - Severe Weather Avoidance Plan (SWAP)	TFM/ARTCC
F&FM	Routes - WIND	TFM/ARTCC
F&FM	Temporary Flight Restrictions (TFRs)	TFM/ARTCC
F&FM	TMI-Airspace Flow Program (AFP)	TFM/ARTCC
F&FM	TMI- Collaborative Trajectory Options Procedures In Use	TFM/ARTCC
F&FM	TMI-Flow Evaluation Areas (FEA)	TFM/ARTCC
F&FM	TMI-Flow Constrained Area (FCA)	TFM/ARTCC
F&FM	TMI-General Aviation Airport Procedures (GAAP)	TFM/ARTCC
F&FM	TMI-Ground Delay Program (GDP)	TFM/ARTCC
F&FM	TMI-Ground Stop Program (GS)	TFM/ARTCC
F&FM	TMI-Special Traffic Management Program (STMP)	TFM/ARTCC
F&FM	TMI-TMA Metering Data (CTA/RTA/STA)	TFM/ARTCC
F&FM	TMI-TMA Metering List	TFM/ARTCC
F&FM	Traffic Demand Forecasts	TFM/ARTCC
F&FM	Traffic Load Forecasts	TFM/ARTCC

F&FM	Traffic Density	TFM/ARTCC
F&FM	Airport Acceptance Rates	TERMINAL
F&FM	Airport Departure Rates	TERMINAL
F&FM	Airport Arrival Approach in Use	TERMINAL
F&FM	Airport Average Taxi Time	TERMINAL
F&FM	Airport D-ATIS Messages	TERMINAL
F&FM	Airport Delays - Terminal Arrival/Departure Delays	TERMINAL
F&FM	Airport Flight Lists-Terminal Demand	TERMINAL
F&FM	Airport Number of Aircraft in Movement Area	TERMINAL
F&FM	Airport Number of Aircraft in Runway Queue	TERMINAL
F&FM	Airport Scheduled Maintenance	TERMINAL
F&FM	Airport Configuration & Status	TERMINAL
F&FM	Airport Runway Configuration & Status	TERMINAL
F&FM	Airport Surface Surveillance Data	TERMINAL
F&FM	Airport TMI - Collaborative Departure Queue Management (CDQM) in Use	TERMINAL
F&FM	Airport TMI - Deicing Operations In Use	TERMINAL
F&FM	Airport TMI - Gate Hold Procedures in Use	TERMINAL
F&FM	Airport TMI - WTMA/WTMD Procedures in Use	TERMINAL
F&FM	Aircraft Arrival Gate - Planned	TERMINAL
F&FM	Aircraft Arrival Gate - Actual	TERMINAL
F&FM	Aircraft Arrival Runway - Planned	TERMINAL
F&FM	Aircraft Arrival Runway - Actual	TERMINAL
F&FM	Aircraft Touchdown Time - Scheduled	TERMINAL
F&FM	Aircraft Touchdown Time - Estimated	TERMINAL
F&FM	Aircraft Touchdown Time - Actual	TERMINAL
F&FM	Aircraft Gate Arrival Time - Scheduled	TERMINAL
F&FM	Aircraft Gate Arrival Time - Estimated	TERMINAL
F&FM	Aircraft Gate Arrival Time - Actual	TERMINAL
F&FM	Aircraft Departure Gate	TERMINAL
F&FM	Aircraft Departure Runway - Planned	TERMINAL
F&FM	Aircraft Departure Runway - Assigned	TERMINAL
F&FM	Aircraft Takeoff Time - Scheduled	TERMINAL
F&FM	Aircraft Takeoff Time - Estimated	TERMINAL
F&FM	Aircraft Takeoff Time - Actual	TERMINAL
F&FM	Aircraft Gate Departure Time - Scheduled	TERMINAL
F&FM	Aircraft Gate Departure Time - Estimated	TERMINAL
F&FM	Aircraft Gate Departure Time - Actual	TERMINAL
F&FM	Aircraft Departure Sequence	TERMINAL
F&FM	Aircraft Digital Taxi Clearance Status	TERMINAL
F&FM	Aircraft Flight Updates - Terminal (Push, Taxi, Queue, Park)	TERMINAL
F&FM	Aircraft Pre Departure Clearance Status	TERMINAL
F&FM	Aircraft Taxi Start Time	TERMINAL
NAS Status	NOTAMs	AIM
NAS Status	FAA Radio Frequencies	AIM
NAS Status	Special Activity Airspace (SAA) Definition	AIM
NAS Status	SAA Status	AIM
NAS Status	SAA Schedules	AIM
Note: Intended non-inclusions: AIM data available on Electronic Flight Bag (EDD) (e.g., static airport configurations, sectional charts, approach plates)		
SAFETY	To Be Determined (TBD)	TBD
SAFETY	Aviation Safety Reporting System (ASRS) Input	Flight

		Deck
SECURITY	TBD	TBD
WX	NextGen Network Enabled Weather (NNEW) Service	NNEW
WX	Corridor Integrated Weather System (CIWS) Data Publication	CIWS
WX	Current Weather Depictions	CIWS
WX	Growth and Decay Trends	CIWS
WX	Convective Weather Forecasts	CIWS
WX	Precipitation and Echo Tops	CIWS
WX	Integrated Terminal Weather Service (ITWS) Data Publication	ITWS
WX	Windshear	ITWS
WX	Microburst	ITWS
WX	Gust Front	ITWS
WX	Precipitation	ITWS
WX	Six-Level Precipitation	ITWS
WX	Ribbon Display	ITWS
WX	Lighting in Storm Cell	ITWS
WX	Storm Motion - Directions	ITWS
WX	Storm Cell	ITWS
WX	Long-range Precipitation Forecasts	ITWS
WX	Short-range Precipitation Forecasts	ITWS
WX	Terminal Convective Weather Forecasts	ITWS
WX	Terminal Winds	ITWS
WX	PIREPs	ITWS
WX	Automated Weather Observation System (AWOS)	AWOS/ ASOS
WX	AWOS Data Acquisition Service (ADAS)	AWOS/ ASOS
WX	Pressure	AWOS/ ASOS
WX	Altimeter Setting	AWOS/ ASOS
WX	Wind Speed	AWOS/ ASOS
WX	Wind Gust	AWOS/ ASOS
WX	Wind Direction	AWOS/ ASOS
WX	Variable Wind Direction	AWOS/ ASOS
WX	Temperature	AWOS/ ASOS
WX	Dew Point	AWOS/ ASOS
WX	Visibility	AWOS/ ASOS
WX	Variable Visibility	AWOS/ ASOS
WX	Day/Night	AWOS/ ASOS
WX	Cloud Height	AWOS/ ASOS

WX	Sky Condition	AWOS/ ASOS
WX	Present Weather Identification Sensor	AWOS/ ASOS
WX	Lightning Detection	AWOS/ ASOS
WX	Freezing Rain Detection	AWOS/ ASOS
WX	Aviation Digital Data Service	ADDS
WX	Turbulence	ADDS
WX	Current Turbulence SIGMETs	ADDS
WX	Graphical G-AIRMET Display	ADDS
WX	Static G-AIRMET Images	ADDS
WX	Graphic Turbulence Guidance (GTG)	ADDS
WX	Icing	ADDS
WX	Current Icing SIGMETs	ADDS
WX	Graphical G-AIRMET Display	ADDS
WX	Static G-AIRMET Images	ADDS
WX	Supplementary Icing Information	ADDS
WX	Freezing Level Graphics	ADDS
WX	Convection	ADDS
WX	Convective SIGMETs	ADDS
WX	National Convective Weather Forecast (NCWF)	ADDS
WX	Radar	ADDS
WX	Collaborative Convective Forecast Product (CCFP)	ADDS
WX	Center Weather Advisory (CWA) and Meteorological Impact Statements (MIS)	ADDS
WX	Watch/Warning Display	ADDS
WX	Severe Wx Product - Mesoscale	ADDS
WX	Severe Wx Product - Day 1 Convective	ADDS
WX	Other "Weather"	ADDS
WX	Volcanic Ash	ADDS
WX	Dust/Sand Storms	ADDS
WX	METARs	ADDS
WX	TAFs	ADDS
WX	Aviation Area Forecast (FA)	ADDS
WX	Satellite	ADDS
WX	International Imagery	ADDS
WX	Western or Eastern US	ADDS
WX	GOES Satellite Imagery	ADDS
WX	Radar	ADDS
WX	Latest Images with Tops	ADDS
WX	Latest Base Reflectivity	ADDS
WX	Single-Site NEXRAD from NWS	ADDS
WX	Terminal Doppler Weather Radar (TDWR) Data	TDWR
WX	45 TDWR Radars	TDWR